EXHIBIT 8

REDACTED

THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

STATE OF TEXAS, ET AL., **Plaintiffs,** **v.** **GOOGLE LLC,** **Defendant.**	Civil Action No.: 4:20-cv-00957 (SDJ)

EXPERT REPORT OF PAUL R. MILGROM

DATE: July 30, 2024

HIGHLY CONFIDENTIAL
SUBJECT TO PROTECTIVE ORDER

auctions suggests that bidders *do* learn to respond to auction design changes over time, and eventually come to adopt nearly profit-maximizing strategies.[30]

30. That finding is no accident. Many advertisers contract with specialized intermediaries (such as advertising agencies) to perform similar optimizations for them,[31] and some advertisers and publishers even employ teams of engineers, economists, and marketing experts devoted to maximizing returns by finding all possible improvements in advertising yields. And even though advertisers and publishers do not in all cases perfectly optimize their returns from display advertising, it is common for them to conduct experiments and learn to adjust their bidding and/or floor pricing strategies, which tends to bring them closer over time to the equilibrium benchmark.

31. For many publishers and advertisers, there are vast sums of money at stake, and online display advertising makes up a significant fraction of their marketing revenue or spend. Moreover, the largest advertisers and publishers make up a significant fraction of the online display advertising industry, suggesting that the strategic sophistication of these agents is especially relevant to auction outcomes.[32] Academic research has often found

[30] *See, e.g.*, Goke, S., Weintraub, G. Y., Mastromonaco, R., & Seljan, S. (2022). Bidders' responses to auction format change in internet display advertising auctions. Available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4021221.

[31] *See, e.g.*, Deposition of [redacted] at 47:7-11 (May 2, 2024) ([redacted]), 93:7-11 ([redacted]); Deposition of [redacted]) at 25:6-20 (May 3, 2024) ("[redacted].").

[32] [redacted] *See* GOOG-AT-MDL-DATA-000486626 to

III. BACKGROUND AND ECONOMIC FRAMEWORK

A. The Key Economic Features of Online Display Advertising

35. Marketplaces are meeting places for trade. Buyers with wants and needs meet sellers of goods or services that can fulfill those wants and needs. When a buyer's value for a good or service exceeds a seller's cost, *both* parties can benefit from trade. Marketplaces provide social value when they facilitate additional opportunities for mutually profitable trade among economic agents.

36. In online display advertising, the key participants include website **publishers**, who sell ads on their websites (also known as **impressions**);[49] the **advertisers**, who buy impressions; and the **end users**, who may view and/or interact with the ads. Publishers use advertising sales to fund their production of internet content, which is often free or subsidized for end users. Advertisers can have many and diverse goals for their advertising campaigns, but they generally seek to increase the probability that an end user engages with their product, service, or message. End users experience benefits and costs from display ads: they may benefit directly from the information conveyed by the ad or indirectly from the ability to consume internet content at a reduced cost (*e.g.*, without facing a paywall), and they may experience costs in the form of the annoyance caused by unwanted advertisements or slower load times for web pages. In this report, because the

[49] In this report, I use the word "impression" to refer to an opportunity for a display advertisement that is offered for sale by a web publisher. This is a broader definition than the technical definition of impression typically used in the industry, which requires that the impression opportunity is successfully allocated to an advertiser and the associated advertisement loads successfully on the end user's browser. For example, Google Ads defines an impression as "[h]ow often your ad is shown[:] An impression is counted each time your ad is shown on a search result page or other site on the Google Network." Google, "Impressions: Definition," Google Ads Help (accessed Dec. 16, 2023), https://support.google.com/google-ads/answer/6320?hl=en.

costs and benefits to end users are difficult to measure and are not the main subject of Plaintiffs' allegations, I focus on the costs and benefits to publishers and advertisers.

37. Occasionally, I will refer to **economic welfare**, by which I will mean the total value to advertisers, minus any costs incurred by publishers and intermediaries. This definition of economic welfare is independent of the prices paid by advertisers for impressions and the fees charged by intermediaries, with these factors determining how economic welfare gets split among advertisers, publishers, and intermediaries.[50] A change in practices is said to **increase efficiency** if it increases economic welfare. For example, a change in matching procedures that leads to assigning impressions to advertisers with higher values increases efficiency and may benefit *both* publishers and advertisers.

38. One of the key challenges facing an advertiser is to identify the appropriate audience for its advertising campaign. The probability that any single ad successfully influences the end user (for example, to click on the ad, buy a product, sign up to an email list, or vote for a political candidate) is typically low.[51] At the same time, the potential benefits to the advertiser from a successful interaction, called a **conversion**, can be significant.

39. In economics parlance, online display advertising is a **matching market** because the value of an impression to an advertiser typically depends on various factors, including the ad shown, the identity of the end user, and the context of the ad. Advertisers are willing

[50] Economic welfare can equivalently be defined as the sum of the advertiser surplus earned by advertisers (see the definition of advertiser surplus in Paragraph 53 below), plus the profits earned by publishers, plus the profits earned by any intermediaries.

[51] For example, according to the [redacted] GOOG-AT-EDTX-DATA-000276098 to -001116097, [redacted]

to pay more to show their ads to end users for whom that ad is more likely to be more relevant. For instance, a restaurant in Dallas, Texas is unlikely to derive much value from advertising its specials to an end user in San Francisco, but may have a high value for advertising them to end users in Dallas, especially those who dine out frequently or have visited that restaurant in the past. The same restaurant might derive more benefit from an advertisement next to a restaurant review in The Dallas Morning News online than from an ad on the sports page. Other advertisers, such as Ticketmaster, might have the opposite preference. Improved matching that places higher value ads for each impression can increase both the price paid to publishers and the profits earned by advertisers.

40. Another key economic feature of online display advertising is that ad impressions on webpages are quickly **perishable**: they must be allocated within fractions of a second of the end user's arrival to maximize the chance that the ad will be noticed. The perishability of impression opportunities distinguishes the matching problem in online display advertising from that faced on other online matching platforms (*e.g.*, real estate platforms like Zillow or dating websites like eHarmony) in which there is typically much more time for counterparties to consider and finalize the details of their matches.

41. These two characteristics—that good matching is key to creating value and that impressions are perishable—distinguish online display advertising platforms from commodity exchanges and from trading platforms for securities like stocks and bonds. In the sale of securities, buyers and sellers often care little about the identity of their trading partners. Partly as a result of that, trading platforms for securities are most often anonymous. In addition, securities are less perishable, with investors sometimes postponing their trading for days or longer if they are unsatisfied with current prices.

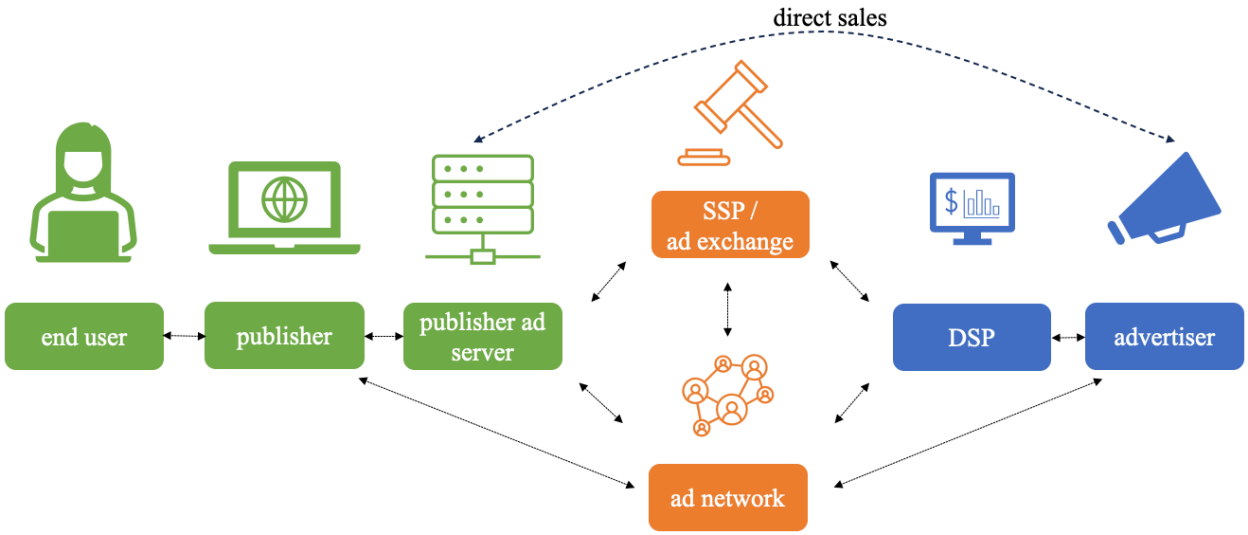
2. The Ad Tech "Stack"

45. To illustrate the various roles of online display advertising intermediaries, consider the following simplified depiction of one of the pathways in the programmatic advertising supply chain. First, an **end user** arrives at a publisher's website, which has an impression opportunity available to be filled by an ad. While the webpage is loading, a **call** can be made to the **publisher's ad server**, which is an intermediary that helps publishers manage their online display advertising inventory. The publisher's ad server may make an initial decision about the allocation of the impression, based on parameters chosen by the publisher. In some cases, the server might allocate the impression directly to an advertiser who has a pre-arranged contract with the publisher. In other cases, the publisher's ad server might make a call to one or more **ad exchanges** or **supply-side platforms (SSPs)**, which allow publishers to sell inventory using programmatic sales mechanisms, including auctions. These auctions typically involve calls to **demand-side platforms (DSPs)**, which are intermediaries that help advertisers purchase online display advertising inventory.[55] The publisher's ad server or the ad exchange might also make a call to one or more **ad networks**, which buy online display advertising inventory directly from publishers or through other intermediaries on behalf of advertisers in their networks. After the winning advertiser is determined, the advertising content is transmitted to the end user's browser by the **advertiser's ad server**, which is an intermediary that manages and stores advertisers' ads. This entire process is completed within a fraction of a second after the arrival of the end user at the publisher's webpage.

[55] I use the terms "buying tool," "buy-side tool," and "DSP" interchangeably in this report.

46. Collectively, these intermediaries are sometimes referred to as the **ad tech stack**, depicted graphically in Figure 2.

Figure 2: Simplified Depiction of the Ad Tech Stack



47. I emphasize that the above is a *simplified* description of the allocation process for *some* online display advertising impressions. Different publishers and supply-side platforms may use allocation processes different from the ones I described above, and advertisers may reach end users through different pathways. Advertising technology has evolved considerably over the past two decades and continues to evolve. Other important intermediaries, which may participate in the ad tech stack but are not included in my simplified description above, include **ad agencies**, which assist advertisers in planning and designing their advertising campaigns, and other intermediaries that assist advertisers and publishers, manage payments, and track user engagement. This description also omits **header bidding**, a technology that allows publishers to call demand sources directly, without first calling a publisher ad server. I discuss header bidding in detail in Sections X and XIII.

48. Another significant function of online display advertising intermediaries is the collection and management of data used by advertisers to identify end users and assess their values for display advertising inventory. One of the key tools used in this process is the **cookie**, which is a small text file stored in an end user's browser.[56] Cookies come in two main varieties: **first-party cookies**, allowing publishers to track user behavior on their own websites, and **third-party cookies**, allowing intermediaries to track user behavior *across* websites.[57] When a user first loads a website including content from an online display advertising intermediary, a third-party cookie is stored in the user's browser. After that time (or until that cookie is deleted in the end user's browser), the display advertising intermediary can track that user's activity across different websites that also include any content from that intermediary.[58] This allows the intermediary to develop a profile of an end user based on his/her browsing behavior, which can help advertisers assess the value of impressions associated with that cookie.[59] Because different display advertising intermediaries have different cookie information about end users, a process called **cookie**

[56] Declaration of [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶ 14 ("In general, cookies are small data files stored on a web browser that can serve different functions.").

[57] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024), https://clearcode.cc/blog/cookie-syncing/ ("Different Types of Cookies [...] First-party cookies are created by the websites we visit directly. [...] Third-party cookies, also referred to as tracking cookies, are collected not by the website, but by advertisers.").

[58] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024), https://clearcode.cc/blog/cookie-syncing/ ("Third-party trackers can also track a user's behavior, such as the content they view on that website and the things they click on (e.g. products and ads). The trackers create third-party cookies and use them to display adverts to the user when they visit different websites. [...] Each time a user visits a website that contains ads (or third-party tracking tags), the browser sends an ad request to an advertising technology platform (e.g. a DSP).").

[59] *See, e.g.*, Declaration of [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶¶ 16 ("[Cookie matching] allows an RTB participant, for example, to limit the bid requests they receive to those involving users that they previously interacted with, as determined by the presence of their cookies."), 39 ("Broadly speaking, these settings and controls will determine [...] whether cookies or other pseudonymous identifiers can be included (where they are available) which enables RTB participants to select ads based on information they may have on prior activity associated with the identifier.").

matching (or cookie syncing) is sometimes used to match (often imperfectly) cookies collected by one advertising intermediary to those collected by another, with this process aided by additional intermediaries, called **data management platforms**.[60] Google offers a cookie matching service to allow bidders in its display advertising auctions to match their cookies with Google's proprietary cookies, called Biscotti.[61] Advertisers often supplement data collected via third-party cookies with other first-party information about the end user to determine their value for displaying an ad.[62]

C. Information, Incentives, and Auctions

1. Auctions Aggregate Dispersed Information

49. One of the challenges associated with efficient matching and intermediation in online display advertising is that information about the value of an impression to different advertisers is typically dispersed and not directly observed by all advertisers, publishers, and intermediaries. An advertiser does not typically have all the information required to assess its value for showing an ad to the end user and needs to rely on information collected by publishers and intermediaries about the user's characteristics and browsing behavior. Meanwhile, a publisher seeking to sell online display advertising inventory

[60] Maciej Zawadziński & Mike Sweeney, "What is cookie syncing and how does it work?," Clearcode Blog (Jan. 31, 2024) https://clearcode.cc/blog/cookie-syncing/ ("An example of this would be mapping a user's ID from a demand-side platform (DSP) to a data management platform (DMP). This process is known as cookie syncing. [...] Cookie syncing works when two different advertising systems (aka platforms) map each other's unique IDs and subsequently share information that they have both gathered about the same user.").

[61] Declaration of [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶ 16 ("RTB participants may utilize their own cookies, in the same way Google uses a Biscotti. 'Cookie matching' allows RTB participants to match their cookies with Google's Biscotti for the same browser.").

[62] *See* Declaration of [redacted] (Redacted) (Sep. 29, 2023), GOOG-AT-MDL-C-000016753, at ¶ 39 ("Broadly speaking, these settings and controls will determine [...] whether cookies or other pseudonymous identifiers can be included (where they are available) which enables RTB participants to select ads based on information they may have on prior activity associated with the identifier.").

to "help make optimal bids to help improve campaign performance."[80, 81] The stated objectives of these tools offered by intermediaries suggest that optimizing returns is a leading goal of advertisers and publishers and that their customers outsource many decisions to intermediaries to reduce the burden of understanding all the details of auction rules and optimizations themselves.

3. Types of Sealed-Bid Auctions

59. Auctions can use a variety of rules to determine allocations and payments. Different auction designs create different incentives for auction participants.

a) Second-Price Auctions and Threshold Pricing

60. A common auction practice early in the history of the online ad industry was the use of **second-price auctions**, in which the highest bidder for an impression wins and pays a price equal to the larger of the floor price or the second-highest bid. The second-price auction rule is the sealed-bid implementation of the well-known **ascending auction**,[82] in which the auctioneer asks for bids at the floor price and gradually increases the price until just one bidder remains. The winning bidder in an ascending auction pays a price that is determined by the drop-out price of the *second-to-last-remaining* bidder, just as the winning bidder in the second-price sealed-bid auction pays a price determined by the bid of the *second-highest* bidder.

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[80] Google, "Enhanced automation," Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/6130826?hl=en.

[81] The surplus-maximization objective of DV360 is also clearly captured in the design of Poirot, as discussed further in Section VII.

[82] *See* Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37.

61. The second-price auction is the canonical member of a class of auctions that uses **threshold pricing**, meaning that the price paid by the winning bidder does not depend on its winning bid but is instead the lowest amount (called the **threshold**) that the winning bidder could have bid to win the auction, holding all other bids fixed. Auctions with threshold pricing can vary in their winner-selection rules: the second-price auction is the auction using threshold pricing in which the highest bid always wins.[83] All auctions with threshold pricing have the following important property: once an advertiser has determined its value for an impression—the maximum price it is willing to pay for that impression—it can maximize its profit in the auction simply by bidding that value.[84, 85] An auction with this property is called **bidder-truthful** (or sometimes **incentive-compatible** or **strategy-proof** or **truthful**).

62. To see why it is always optimal with threshold pricing for the advertiser to bid its value, v, there are two cases to consider. First, suppose that the minimum bid needed to win the auction is some amount x, which is less than v. Then, bidding the advertiser's value v will win the auction and, by the threshold pricing rule, the winner will pay x. Any other bid either wins the auction at the same price or loses the auction (guaranteeing zero payoffs), so no other bid can do better: bidding v maximizes the bidder's surplus. Second, suppose

[83] As another example, a publisher's online ad auction might specify that some favored bidder wins an impression if its bid plus 25% is higher than any other bid; otherwise, the item goes to the highest other bidder. Using this rule to determine the winner results in the favored bidder, when it wins, paying a discounted threshold price. For example, if the highest bid from a regular customer is 100 and the favored bidder bids more than its threshold of 80, then it wins and pays a price of 80, even if its own bid was, say, 90.

[84] Milgrom, P., & Segal, I. (2020). Clock auctions and radio spectrum reallocation. *Journal of Political Economy*, *128*(1), 1-31, at 16-18 ("Proposition 3. Any threshold auction is strategy-proof. Conversely, any strategy-proof direct auction has a monotonic allocation rule, and if V=R^N_+, it must be a threshold auction.").

[85] Bidder-truthfulness applies to a single auction for an impression. When the same agents interact in multiple auctions, advertisers may have different incentives leading them not to bid their values. For example, an advertiser may not want to reveal that it has a high value for an impression if it anticipates that the publisher will change its floor price in subsequent auctions to take advantage of that information.

that the minimum bid to win the auction is some amount y, which is greater than v. Then, bidding the advertiser's value v will lose the auction, but any winning bid would require that the advertiser pay a price y, which is more than its value. So, in this second case, too, there is no bid that earns the advertiser more than bidding its value v.

63. Bidder-truthful auctions reduce bidding errors and the costs of bidding because they eliminate any need for an advertiser to assess who else might be bidding, how much they might bid, or the publisher's floor price. In non-bidder-truthful auctions, each advertiser's bid depends on all of these factors. I have previously advised auctioneers to adopt bidder-truthful auctions, highlighting the importance of easy bidding.[86]

64. Other auctions using threshold pricing besides the second-price auction were used in several of Google's programs, as described later in this report. Threshold pricing is special not just because it results in bidder-truthful auctions, but also because these are the *only* bidder-truthful auctions. There are no others.[87] Any auction in which a winning bidder pays something other than its threshold price is not bidder-truthful, and as a consequence, incentivizes bidders to choose bids that differ from their values for the good being sold.

[86] When the US Federal Communications Commission sought to repurchase certain television broadcast rights, I advised a bidder-truthful auction so that for any television broadcaster, "the hardest part of bidding will be to determine its value of continuing to broadcast. Once it knows that value, the rest is easy. The bidder cannot do better than to agree to accept any price greater than its value of continuing to broadcast and then to exit if its offered price falls lower than that. By bidding in this way, the station will obtain its best possible price[…]" Auctionomics and Power Auctions, "Incentive Auction Rules Option and Discussion," FCC (Sep. 12, 2012), https://docs.fcc.gov/public/attachments/FCC-12-118A2.pdf, at 3.

[87] For proof, notice that if the price paid by a winning bidder depends on its bid, then instead of bidding truthfully, a bidder prefers to make the winning bid that results in the lowest price. *See* Milgrom, P., & Segal, I. (2020). Clock auctions and radio spectrum reallocation. *Journal of Political Economy*, *128*(1), 1-31, at 16-18.

65. Google recognized the advantages of bidder-truthful auctions, explaining them as follows: "It's faster, less costly, and more fair to the less sophisticated advertisers to structure the auction in favor of true value."[88] The lower transaction costs associated with bidding in a bidder-truthful auction encourage advertisers to participate on Google's platform, which increases thickness, tending to improve the efficiency of its allocations and increase the prices paid to publishers.[89]

66. Second-price auctions have an additional important benefit: if bidders bid truthfully, then the price determined by the auction for each impression is a **market-clearing price**. A market-clearing price is one at which supply equals demand—one bidder is willing to pay the price and no losing bidder is willing to pay more. Whenever an impression is transacted at a market-clearing price, that transaction maximizes the economic welfare that can be created from the sale of the impression. It can be proved mathematically that the second-price auction is the only bidder-truthful auction that always transacts the impression at a market-clearing price.[90]

b) First-Price Auctions

67. In a first-price auction, the bidder with the highest bid wins and pays a price equal to its bid for the item (unless the highest bid is below the floor price, in which case the item is unallocated). In contrast to the second-price auction, *every* bidder in a first-price auction needs to **shade** its bid—that is, choose a bid *less* than its value—in order to stand any

[88] "GDN Auction Overview" (Oct. 11, 2014), GOOG-AT-MDL-001094067, at -085.

[89] *See, e.g.*, Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37.

[90] *See* Milgrom, P. (2004). *Putting auction theory to work*. Cambridge University Press, at 71-73.

chance of making a profit.[91] From a bidder's perspective, its optimal bid shading results from a tradeoff: a higher bid increases the probability of winning an impression, but it also increases the bidder's price for the impression if it wins. The optimal shading calculation depends on the bidder's estimates or guesses about what others might bid: the bidder should reduce its bid more if it expects lower bids from others. Guessing the identities and bids of others for each different impression is a costly and error-prone activity that can lead to inefficiency when bidders' guesses are wrong. In a first-price auction, the winner may be a bidder who does not have the highest value for the impression. Even when the impression is allocated correctly, the winning bid may not be a market-clearing price: after seeing the outcome, some losing bidders may have been willing to pay more than the winning bid for that impression.

68. While second-price auctions are bidder-truthful, first-price auctions have their own advantages. One important benefit of the first-price auction is its transparency. Unlike in a second-price auction, the winning bidder always pays its bid, so it does not need to trust the auctioneer's computations or reports of floor prices and other bids in order to confirm that the price it pays was determined properly. Among sealed-bid auctions, only first-price auctions are what auction theorists have called **credible auctions**, which means that the auctioneer has no profitable way to cheat that is not immediately detectable by the winning bidder.[92] This credibility property is one reason that first-price

[91] Bid "shading" is a term of art in the economic theory of auctions, dating back to at least the seminal work of William Vickrey. *See* Vickrey, W. (1961). Counterspeculation, auctions, and competitive sealed tenders. *Journal of Finance*, *16*(1), 8-37, at 12-13 ("On the other hand, if traders have a fairly confidently held expectation that the equilibrium price will fall within a certain narrow range, there may be an indirect community of interest in shading the reported demand and supply curves outside this range in the direction of greater inelasticity"). The term has also been used to describe bid optimization in the online display advertising industry.

[92] Akbarpour, M., & Li, S. (2020). Credible auctions: A trilemma. *Econometrica*, *88*(2), 425-67, at 427.

call might cause a bidder to win the auction at the inflated price. If there was no winner at the high price, the publisher would call the exchange again, offering the same impression with a lower floor price. As a result, if the publisher engages in multi-calling, it is not generally optimal for an advertiser to bid its value: the winning advertiser may be able to buy the impression at a lower price by reducing its bid, letting the impression go unsold in the first auction, and then winning in a later auction at a lower price. Multi-calling destroys the simplicity of threshold pricing and so complicates bidding for advertisers, forcing them to strategize about how best to respond to the publisher's practice and make guesses about the publisher's true floor price and about others' bids. Multi-calling also increases processing costs and adds latency, damaging the end user's online experience and leading to a reduction in advertising effectiveness.[104]

78. *Third*, as online display advertising platforms evolved to accept more bids from different demand sources in each auction, **self-competition**—which occurs when an advertiser submits multiple bids for the same impression—became a larger concern for advertisers. Self-competition can occur as a result of **advertiser multi-homing**,[105] in which an advertiser uses multiple DSPs to submit bids for an impression, or **DSP multi-homing**,[106]

[104] *See, e.g.*, Oded Poncz, "Traffic duplication might be a bigger problem than ad fraud," AdExchanger (Jan. 11, 2016), https://www.adexchanger.com/data-driven-thinking/traffic-duplication-might-even-be-a-bigger-problem-than-ad-fraud/ ("Another side effect of bid request duplication is that re-auctioning a bid takes time. In some cases, this could even become apparent to the end user.").

[105] [redacted] GOOG-DOJ-AT-02524665, at -666, -670. *See also, e.g.*, Deposition of [redacted] at 40:18-23 (Sep. 6, 2023), [redacted], at -040 ("[redacted]").

[106] *See, e.g.*, Deposition of [redacted] at 51:10-12, 54:4-6 (Sep. 26, 2023), [redacted], at -052, -055 ("[redacted]").

in which a DSP submits bids into multiple exchanges on behalf of a single advertiser. When the same bidder submits multiple bids in a second-price auction, it may wind up making both of the two highest bids, with its own second-highest bid setting its price. In such cases, the advertiser would pay a lower price if its second bid were lower or omitted. Bidders would need to adjust their bids to avoid this possibility, requiring more complicated bidding strategies.

79. *Fourth*, some exchanges tried to increase their profits by using **non-transparent auctions**, claiming to calculate the winner's price using a second-price rule, but actually charging winners a larger amount, for example by using the 1.5-price rule described earlier.[107] Such practices make participation in the auction less safe for advertisers and reduce trust in online display advertising intermediation more generally, harming other exchanges and economic welfare. In order to protect against non-transparent auctions, bidders would need to invest in costly technology to detect exchanges using non-second-price auction rules and to optimize bids into those exchanges.

80. Many intermediaries adopted practices to reduce the potential harms associated with the four challenges I described above,[108] and eventually ad exchanges across the industry responded by switching away from a second-price auction format. Most exchanges,

[107] [redacted]

[108] For example, Projects Bell and Poirot at Google were designed to respond to multi-calling and non-transparent non-second-price auctions, respectively. Non-Google display advertising intermediaries also introduced similar products, as demonstrated in Table 1 and discussed below.

D. Google's Products

82. Along with many other companies, Google provides a variety of intermediary services in online display advertising. In this report, I study the practices of a number of Google's intermediaries: on the demand-side, **Google Ads** and **Display & Video 360 (DV360)**, and on the supply-side, **Google Ad Manager (GAM)**, which incorporates advertising exchange functionality (formerly known as **AdX**) and publisher ad server functionality (formerly known as **DFP**).

1. Display & Video 360

a) How Advertisers Use DV360

83. **DV360** (formerly known as DoubleClick Bid Manager or DBM) is a demand-side platform that offers tools for "planning [display advertising] campaigns, […] designing and managing creative[s], organizing audience data, finding and buying inventory, and measuring and optimizing campaigns,"[112] enabling advertisers to "manage their reservation, programmatic, and programmatic guaranteed campaigns across display, video, TV, audio, and other channels, all in one place."[113] As I described above, DV360 offers automated tools to "help make optimal bids to help improve campaign

[112] Google, "Display & Video 360 overview," Display & Video 360 Help (accessed Jan. 21, 2024), https://support.google.com/displayvideo/answer/9059464?hl=en.

[113] Google, "Display & Video 360: An integrated solution for end-to-end advertising campaigns," Display & Video 360 (accessed Oct. 31, 2023), https://services.google.com/fh/files/misc/display_and_video_360_product_overview.pdf.

performance."[114] DV360 allows advertisers to purchase ads from many sell-side platforms, including AdX, Index Exchange, OpenX, Rubicon, and others.[115]

84. Advertisers on DV360 can set up their campaigns in multiple ways. In the early days of DV360, most advertisers used DV360 to set up **fixed CPM** campaigns, in which the advertiser would report to DV360 the characteristics of the impressions they would like to purchase with each campaign and a fixed CPM—cost per mille (thousand impressions)—and DV360 would use that CPM to bid in auctions for those impressions.[116] Fixed CPM bidding is still offered as an option on DV360, but [redacted] **automated bidding** campaigns,[117] in which the advertiser reports an objective to DV360 (for example, "maximize clicks" or "maximize conversions" subject to a budget) and DV360 applies prediction and optimization algorithms to "dynamically determine the optimal bid price for a given impression for an advertiser."[118] More recently, DV360 introduced **custom**

[114] Google, "Enhanced automation," Display & Video 360 Help (accessed Oct. 31, 2023), https://support.google.com/displayvideo/answer/6130826?hl=en.

[115] Sissie Hsiao, "How our display buying platforms share revenue with publishers," Google Ad Manager (Jun. 23, 2020), https://blog.google/products/admanager/display-buying-share-revenue-publishers/ ("Using Display & Video 360, these advertisers can buy ads on more than 80 publisher or sell-side platforms including AT&T, Comcast, Index Exchange, OpenX, Rubicon Project, MoPub and others.").

[116] Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -553 ([redacted]).

[117] Presentation, "DV360 optimizations ENG deep dive" (Jan. 24, 2020), GOOG-DOJ-11733552, at -555 ([redacted]).

[118] Comm Doc, "[redacted]" (Mar. 2019), GOOG-DOJ-05326023, at -023.

2. Google Ads

a) How Advertisers Use Google Ads

87. **Google Ads** (formerly known as AdWords) is a buy-side tool that permits advertisers to create ad campaigns that run across different formats, including search and display ads.[126] In this report, I focus on the online display advertising functions of Google Ads on web properties other than those owned and operated by Google.

88. Advertisers on Google Ads specify campaign goals (*e.g.*, maximizing clicks or conversions) and constraints for a campaign (*e.g.*, types of end users to target, maximum bids or budgets), and Google Ads uses that information to determine bids for impressions.[127] Advertisers can also specify "manual" bids for impressions on a CPC (cost-per-click) or CPM basis.[128] In this report, for simplicity, I use the word "bid" to refer to either the manual bid reported by the Google Ads advertiser or the bid determined by Google Ads as a function of the advertiser's reported campaign goals, whichever is relevant for that advertiser.

89. Originally, beginning in 2003, advertisers could use Google Ads to buy third-party display advertising inventory only from publishers using AdSense, a Google supply-side

[126] Google, "Google Ads" (accessed Jan. 5, 2024), https://ads.google.com/intl/en_us/home/.

[127] Google, "Determine a bid strategy based on your goals," Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/2472725 ("Depending on which networks your campaign is targeting, and whether you want to focus on getting clicks, impressions, conversions, or views you can determine which [bidding] strategy is best for you.").

[128] Google, "Determine a bid strategy based on your goals," Google Ads Help (accessed Oct. 31, 2023), https://support.google.com/google-ads/answer/2472725 ("Manual CPC bidding: This lets you manage your maximum CPC bids yourself. […] CPM: With this bid strategy, you'll pay based on the number of impressions (times your ads are shown) that you receive").

auction capabilities of GAM is particularly important, I use the older names, DFP and AdX.

97. Publishers include code snippets (called **Google Publisher Tags** or **GPTs**) in their web pages to trigger a **call** or **ad request** to GAM.[147] This ad request contains information about the impression opportunity, including the URL of the website, any available user-related information, and characteristics of the impression opportunity (including its size and location on the page).[148] After an ad request is received, GAM uses decisioning logic to determine which ad to serve.[149] Publishers configure this decisioning logic in the GAM interface using various controls, including **line items**.[150]

98. Line items are GAM's way of encoding information about sources of advertising demand.[151] **Guaranteed line items** are the line items used for campaigns for which the advertiser and publisher have a directly negotiated contract.[152] Guaranteed line items contain information about the advertiser's campaign goal (*e.g.*, number of impressions,

[147] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -487 to -488 ("GPT is a Javascript library that publishers use to tag their web pages so they can talk to Google Ad Manager backend.").

[148] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -488 ("The Ad Request contains information about the impression: URL of the site[,] Browser User Agent[,] Slot parameters (Ad Unit, size, key/value pairs)[,] etc. Ad Request also contains user-related information like Cookies, User IDs, etc, that can be later at the backend matched to user demographics and behavior profiles, audience segments, etc.").

[149] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -492 ("[redacted]").

[150] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490.

[151] *See* Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490 ("Line Items represent campaigns / campaign elements within AdManager.").

[152] Google, "Line item types and priorities," Google Ad Manager Help (accessed Jan. 7, 2024), https://support.google.com/admanager/answer/177279?hl=en ("Guaranteed line items […] Standard […] Use this line item type for directly sold campaigns when your buyer wants a specific number of impression[s] to serve.").

clicks), campaign duration, campaign priority, frequency, and targeting criteria.[153] **Non-guaranteed line items** can be used to represent sources of demand for **remnant impressions**, which are impressions not allocated to guaranteed contracts. Those sources of demand include ad networks and non-Google ad exchanges.[154] Until the introduction of EDA in 2014 (see Section III.D.3.e below), guaranteed line items were always prioritized over non-guaranteed line items.[155] Other types of line items can be used to trigger calls to auctions on AdX.[156] Different line items may be relevant for different ad opportunities, depending on publisher decisions in the GAM interface.

b) Early Online Display Advertising and the Waterfall

99. In the early 2000s, online display advertising impressions were primarily sold via either directly negotiated guaranteed contracts between publishers and advertisers, or non-guaranteed contracts between publishers and **ad networks**.[157] Ad networks typically offered to purchase remnant impressions at a fixed or pre-negotiated price, with no

[153] *See* Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -490 ("Line Items define things line [sic]: Campaign goal (how many impressions, clicks, etc)[,] Campaign duration[,] Campaign priority[,] Frequency capping (how often should it appear for one user)[,] Targeting (where and to whom should the campaign serve)").

[154] Google, "Line item types and priorities," Google Ad Manager Help (accessed Jan. 7, 2024), https://support.google.com/admanager/answer/177279?hl=en ("Any third-party ad network or exchange that provides an appropriate ad tag can be represented by a non-guaranteed line item").

[155] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 12 ("From the launch of Dynamic Allocation in around 2007 until Google introduced Enhanced Dynamic Allocation in 2014, line items determined to be 'guaranteed' on a request were always served without considering AdX, AdSense, or any line items determined to be 'non-guaranteed' on that request.").

[156] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -491 ("There are 3 main Line Item types in AdManager with subtypes that differ by campaign goal").

[157] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413.

obligation on the publisher to fill a minimum number of impressions.[158] As compared to direct deals, ad networks typically did not give a publisher as much control over the ads that would be placed on its website, or the prices it received for any individual impression.[159] While direct contracts and ad networks continue to play an important role in online display advertising, over time, more sophisticated technologies emerged to allow publishers and advertisers to identify more valuable matches.

100. One technology that emerged early in the online display advertising industry was the capability of ad networks to "passback" an unwanted impression for which they did not have a relevant advertisement, allowing the publisher to offer the impression to other demand sources.[160] This passback capability led to the **waterfall**, in which a publisher specified (using code snippets called "passback tags") a list of demand sources to be contacted sequentially.[161] In a waterfall, the first demand source was offered the

[158] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Publishers usually sell their remaining ad space on a non-guaranteed (or 'pre-emptible') basis through their direct sales channel, as well through their indirect sales channel, which may comprise a handful of ad network partners. […] Non-guaranteed ads […] typically sell at a lower price because of the potential that another buyer will pay a higher price after the initial sale, before the impression is actually delivered; hence the 'non-guaranteed' status. With indirect sales, the CPM is usually fixed, but the number of impressions delivered is not.").

[159] *See* David Kaplan, "On Ad Networks: Pork Bellies, Diamonds, Or The New Direct Marketing?," Forbes (Apr. 8, 2008), https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e ("All ad networks are not created equal: If all sides can agree on one thing, it's the need for greater clarity to what's being sold and where it's being placed. […] 'In a lot of cases [in terms of ad nets' handling of remnant, or unsold ad inventory], the buyer doesn't really know what they're getting. And the seller doesn't have any control over price.'"). *See also* AffiliateSeeking.com, "Ad Networks" (captured on Jan. 16, 2008), https://web.archive.org/web/20080116101025/https://www.affiliateseeking.com/list/23000001/1.html (listing some examples of ad network pricing options).

[160] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503 ("Passback means that when one ad system cannot fill an ad request it passes it back to a different ad system.").

[161] *See* Maciej Zawadziński and Mike Sweeney, "What is Waterfalling and How Does it Work?," Clearcode Blog (Sep. 1, 2016), https://clearcode.cc/blog/what-is-waterfalling/("Waterfalling, also known as a daisy chain or waterfall tags, is a process used by a publisher to sell all remnant inventory. […] Waterfalling gets its name from the waterfall-like process for selling inventory—*i.e.* the demand sources are initiated one at a time, one after another."); Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -503.

opportunity to fill an impression. If that demand source declined to fill the impression (or did not have an eligible ad to serve for the impression), the request was passed back to the next demand source on the publisher's list, with the process repeating until the impression was sold or the publisher's list was exhausted, leaving the impression unsold. The waterfall was a highly configurable process, with publishers free to set the order of consideration and prices for each demand source however they wished.

c) AdX Uses Auctions to Match Publishers and Advertisers

101. **AdX** (formerly known as DoubleClick Advertising Exchange or DoubleClick AdX) launched in 2007 and was designed to "bring Web publishers and advertising buyers together on a Web site where they can participate in auctions for ad space."[162]

102. When AdX receives a call from DFP, it runs an auction on behalf of a publisher.[163] This call contains information about the impression and a floor price for the auction. Prior to 2009, buyers did not vary bids based on real-time information about impressions: instead, if an ad opportunity with certain criteria matching the buyer's stated criteria became available, AdX would run an auction using each buyer's *pre-determined* bid for that type of impression.[164] Since the launch of AdX 2.0 in September 2009, AdX has supported **real-time bidding**.[165] Under real-time bidding, AdX sends bid requests containing

[162] AdX was originally launched by DoubleClick, prior to its acquisition by Google. *See* Louise Story, "DoubleClick to Set Up an Exchange for Buying and Selling Digital Ads," New York Times (Apr. 4, 2007), https://www.nytimes.com/2007/04/04/business/media/04adco.html.

[163] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -513.

[164] *See* DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136.

[165] Email from [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 ("The team has done a great job

information about the auction to **Authorized Buyers** (previously known as "AdX buyers" and consisting mostly of ad networks and non-Google DSPs), and triggers a request to Google's buy-side products, Google Ads and DV360, to calculate bids.[166] AdX then runs an auction using the bids that it receives, and it then returns the winning ad to DFP, which serves the ad to the publisher's website.[167] Since the launch of Open Bidding, discussed further in Section III.D.3.g and Section XIII, GAM has also incorporated bids on impressions from non-Google exchanges for publishers that enable it.

103. From its launch until 2019, AdX used a second-price auction to allocate impressions.[168, 169] The highest bid, net of the AdX revenue share, would win the auction as long as that net bid was above the floor price. AdX would then charge the winning bidder its threshold price, which is equal to the higher of the second-highest bid in AdX or the auction's floor price.[170] In April 2015, DFP introduced a feature called **Reserve Price Optimization (RPO)** (also known as **Optimized Pricing**) which helped publishers set floor prices in the AdX second-price auction by increasing some floor prices in bid requests to buyers when RPO predicted—based on historical data on the distribution of

[…] to also go beyond in some important areas, *e.g.* […] Real Time Bidding, and of course integration with Adsense and Adwords.").

[166] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -500 to -502 ("The buyer facing side of Google Ad Exchange is called Authorized Buyers […] Ad Exchange sends a Bid Request to DSPs with this information asking them to bid on the impression.").

[167] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -502.

[168] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 5.

[169] During the period in which DRS v1 and v2 was in effect, AdX would charge the winning bidder a price higher than the second-price in a small minority of auctions. See Section XII below.

[170] As noted above, DRS v1 and v2 could change the price paid by advertisers for some impressions.

bids—that the higher floor prices would increase publisher revenues.[171] I discuss RPO in detail in Section XI.

104. In 2019, AdX transitioned to a first-price auction, which I discuss in more detail in Section XIII below.[172]

105. AdX uses a revenue share model to charge publishers for impressions sold on AdX.[173] AdX keeps a proportion of the total revenue from the sales of the publishers' impressions on AdX in a given calendar month, with this proportion referred to as the **AdX revenue share**. The remaining proportion of the revenue, which is passed on to the publisher, is called the **publisher's revenue share**. In combination with the auction's pricing rule (which determines the price paid by bidders in the auction), the revenue share split determines the total payments AdX makes to each publisher. The baseline AdX revenue share is 20%, but different types of transactions can have different revenue shares, and the revenue share could be changed by contract between AdX and the publisher.[174] Until

[171] Email from [redacted] "Re: [drx-pm] LAUNCHED! Dynamic Pricing (RPO) for AdX sellers" (Nov. 12, 2015), GOOG-DOJ-07235914, at -915 ("Between April and October we launched and improved new systems to dynamically set auction reserve prices for AdX sellers."); Comms Doc, "Optimized pricing in the Open Auction Comms" (Mar. 23, 2018), GOOG-DOJ-04937154, at -154 ("Optimized pricing in the Open Auction […] formerly known as Reserve Price Optimization (RPO)").

[172] Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/ ("in the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 7.

[173] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Revenue share is the pricing model for Ad Exchange.").

[174] *See* Google, "Google Platform Services Terms and Conditions," Google (accessed Sep. 27, 2023), https://www.google.com/google-ad-manager/platform/terms/, at Section 4.1.a; Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Baseline revenue share is 80/20 which means that of every dollar an advertiser pays (Gross value), 80 cents go to publisher and 20 cents go to Google. […] Different types of transactions might have a different revenue share and this might be negotiable during contracting phase.").

August 2015, a publisher would receive the same, fixed revenue share on each impression won by AdX.[175] After the introduction of **Dynamic Revenue Share for AdX** (hereinafter **sell-side DRS**) in August 2015, and until AdX transitioned to a Unified First Price Auction in 2019, AdX allowed the revenue share to vary on individual impressions to sell more total impressions and to increase the overall returns to publishers, as I discuss further in Section XII below. AdX does not generally charge fees to advertisers.[176]

106. The revenue share model helps to align the interests of Google and publishers. Each publisher and Google receive a fixed proportion of the publisher's monthly sales revenue on AdX, so that both parties share in any additional revenues when the total volume or the average price per impression of sales on AdX increases. This degree of alignment allows publishers to safely delegate certain decisions to Google and to benefit from Google's efforts to make its marketplace thicker and more efficient.

d) Dynamic Allocation Benefits Publishers and Improves Efficiency

107. In 2007, DoubleClick introduced **Dynamic Allocation (DA)** in DFP.[177] Using DA, publishers could configure DFP to ensure that the impression was sold on AdX only when an AdX buyer was willing to pay *more* than the amount the publisher expected to

[175] "AdX dynamic sell-side rev share (DRS v1) - project description / mini PRD" (Aug. 2014), GOOG-DOJ-03619484, at -484 ("There is a 20% share on all transactions"); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 28.

[176] Presentation, "Ad Manager Ecosystem 101" (Jun. 2019), GOOG-DOJ-AT-02199478, at -514 ("Ad Exchange does not impose a buy-side fee").

[177] Dynamic allocation was created by DoubleClick prior to its acquisition by Google. *See* User Guide, "DoubleClick Advertising Exchange User Guide (Beta)" (Mar. 29, 2007), GOOG-DOJ-AT-01133273, at -277 ("Dynamic allocation for sellers. DoubleClick Advertising Exchange automatically determines how to generate the highest return for every impression by dynamically allocating to the highest paying sales channel.").

receive from any other demand source.[178] In contrast to previous ad allocation technologies (including the waterfall), when impressions were sold to AdX buyers, payments to publishers under DA were determined using an auction process, which ensured that the price of each impression was determined by bidders' demands.

108. DA worked as follows. For each remnant line item in DFP (representing, for example, an ad network), publishers would configure a **value CPM** (sometimes called a **static bid**), which determined how that remnant line item would compete with AdX demand under DA.[179] Publishers could set the value CPM for each remnant line item as they pleased and could create multiple line items with different targeting criteria for the same demand source to allow different value CPMs to be used for different categories of impressions.[180] Given these value CPMs, DA used a two-step process to allocate remnant impressions.[181] First, it would identify the eligible[182] non-guaranteed line item with the highest value CPM, called the **DFP booked price** for the auction. In the second step, AdX would run a second-price auction among its demand partners, with a floor price that was at least as

[178] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 ("Instead of randomly rotating other ads into an ad slot, DoubleClick Ad Exchange uses Dynamic Allocation, rotating in higher-paying ads from ad networks and other third-party media buyers when the net CPM they provide to the publisher is higher than what has been booked directly into the ad server.").

[179] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11; Google, "Value CPM," Google Ad Manager (accessed Oct. 15, 2023), https://support.google.com/admanager/answer/177222?hl=en("The value CPM (cost per thousand impressions) is an amount you specify to help Google Ad Manager estimate the value of campaigns. The amount entered in the 'Value CPM' field serves two purposes: 1. It's used in revenue calculations for impressions served. 2. When a value CPM is defined for remnant line items, the value CPM is used for competition in dynamic allocation and First Look instead of the 'Rate' value.").

[180] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 11.

[181] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 10.

[182] A line item was "eligible" if the impression met the terms of the non-guaranteed contract between the publisher and the demand source (*e.g.*, based on targeting criteria).

high as the DFP booked price.[183] If a buyer on AdX was willing to pay more than the floor price, it was awarded the impression and paid the auction's clearing price (adjusted for the AdX revenue share); otherwise, the impression was allocated to the best non-guaranteed line item (which might then passback the impression to other demand sources, as in the waterfall).[184]

109. DA benefited publishers and improved efficiency, increasing the total value of online display advertising to advertisers. If publishers set a value CPM for each line item that was at least as large as the expected return from allocating an impression to that demand source, DA was a *risk-free improvement in their expected revenue*: DA would assign an impression to AdX only if it could pay more than the return the publisher expected from any other demand source. Advertisers also benefited from the ability to make higher bids for impressions they valued highly and lower bids for impressions they valued less in the AdX auction, allowing them to focus their spending on impressions they valued the most. These benefits of DA were amplified when AdX transitioned to real-time bidding in 2009.

110. I provide a more detailed analysis of the benefits of DA in Section VIII.

[183] If the publisher had otherwise set a floor price for the impression that was higher than the DFP booked price, that floor price would apply.

[184] Presentation, "Understanding the AdX Auction" (Oct. 2014), GOOG-DOJ-12443562, at -582 ("If we decide to call other network and they have nothing, they can pass it back"); Vijay Sivasubramanian, "Help me with Waterfall setup and understanding Passback Tags," Google Ad Manager Help (Mar. 6, 2019), https://support.google.com/admanager/thread/2065360/help-me-with-waterfall-setup-and-understanding-passback-tags?hl=en("You need to give the passback tag which you generated in GAM to the respective network partner. They will place that passback tag as backup ads. So that it will call next ad partner when you target the passback ad unit."); Stack Overflow, "What are advertising passback tags and common implementation" (Feb. 19, 2014), https://stackoverflow.com/questions/19112923/what-are-advertising-passback-tags-and-common-implementation ("When your primary ad-network doesn't have anything to serve (for example, there isn't an advertiser willing to pay a high enough CPM), you can send that impression back to your default advertiser's tags to serve. […] Passback tags allow you to implement a so-called waterfall model").

resolving its header bidding auction.[198] This so-called "**last look**" was not a Google program: it arose as a consequence of the way that some publishers integrated header bidding into DFP using the line item capabilities that DFP (like other publisher ad servers) supported at the time header bidding was introduced.[199] In Section X, I examine the so-called "last look" and show that it was not a source of advantage for Google, contrary to the allegations made by Plaintiffs.

117. Header bidding has benefits and costs for publishers. On the benefits side, header bidding could help publishers increase their online display advertising revenues by collecting more real-time bids for impressions. On the costs side, header bidding has at least four disadvantages. First, it is relatively complex to configure.[200] Second, it often increases page load latency.[201] Third, it makes it more complicated for advertisers to bid optimally because of the possibility of self-competition, where an advertiser drives up the price it pays by unknowingly bidding against itself for the same impression in multiple places.[202]

[198] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 14.

[199] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 17 ("'[L]ast look' was not designed to give AdX an advantage when competing against Header Bidding. It was simply the result of the Header Bidding auction taking place before the AdX auction ran and the way that publishers configured Header Bidding line items to work with Dynamic Allocation.").

[200] One publisher described the time required to integrate an SSP with a leading header bidding wrapper as "20 hours of work" (versus Open Bidding's "20 minutes"). *See* Sarah Sluis, "Google Ad Manager Builds A Bridge To Prebid—But Don't Call It A Two-Way Street," AdExchanger (Apr. 27, 2022), https://www.adexchanger.com/platforms/google-ad-manager-builds-a-bridge-to-prebid-but-dont-call-it-a-two-way-street/. Another industry source compares header bidding to previous ad configurations: "It's not just a little more work, it's probably 100X as much work to traffic for most publishers," *See* Ad Ops Insider, "Header Bidding Explained Step-by-Step" (Jun. 8, 2015), https://www.adopsinsider.com/header-bidding/header-bidding-step-by-step/.

[201] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24. *See also* Vishveshwar Jatain, "Understanding Header Bidding And How To Leverage It," Forbes (Sep. 17, 2019), https://www.forbes.com/sites/forbescommunicationscouncil/2019/09/17/understanding-header-bidding-and-how-to-leverage-it/?sh=332097315c18("Client-side header bidding […] increased page latency because executing auctions takes bandwidth and computing resources."); Pachilakis, M., Papadopoulos, P., Markatos, E. P., & Kourtellis, N. (2019). No more chasing waterfalls: a measurement study of the header bidding ad-ecosystem. In *Proceedings of the Internet Measurement Conference* (pp. 280-293).

[202] *See* Presentation, "Optimal AdX in DFP setup: Best practices, and how to traffic RTA/RTP (header bidding) line items" (Sep. 24, 2015), GOOG-TEX-00000001, at -004 ("[H]eader bidding can make buyers bid against themselves

Fourth, there were reports of payment discrepancies between the bids of header bidding exchanges and eventual payments.[203] I discuss these benefits and costs of header bidding further in Sections X and XIII.

g) Open Bidding Allowed Non-Google Exchanges to Compete in a Unified Auction, Benefiting Publishers and Increasing Platform Thickness

118. Google began testing **Open Bidding** (formerly known as Exchange Bidding, demand syndication, and EBDA) in 2016 and officially launched it in April 2018. Open Bidding allowed publishers to run an auction using real-time bids from multiple ad exchanges, including AdX and competing ad exchanges, within GAM. Some employees described Open Bidding as Google's "answer to header bidding."[204] Open Bidding allows non-Google exchanges to compete for an impression in an "auction of auctions" in which bids from Authorized Buyers, DV360, Google Ads, and other remnant line items booked by publishers in GAM (which might include header bidding line items) compete head to head.

running 2 auctions for every impression."); Deposition of [redacted] at 132:4-7 (Jul. 28, 2023), [redacted], at -132 ("[redacted]").

[203] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Header bidding is also not transparent because, although the publisher 'accepts' the impression at a certain price, the header bidder may not actually pay the sum indicated in its bid."); Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -955 ("A comparison of HB reports vs DFP reporting showed significant discrepancies [in revenue]"). *See also* James Curran, "Opinion[:] For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a 50% discrepancy between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a $2 CPM is really a $1 CPM once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[204] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337.

119. Publishers determine which demand sources are eligible to compete under Open Bidding using the GAM interface. Under Open Bidding, a publisher needs to establish a contractual relationship with an Open Bidding partner in order to allow it to compete for the publisher's impressions.[205] When an impression arrives for which Open Bidding is eligible, GAM sends a request to AdX and participating Open Bidding exchanges. The Open Bidding auction design changed several times during testing, as I discuss in detail in Section XIII.

120. The introduction of Open Bidding benefited publishers and thickened the Google online display advertising platform, by simplifying the process of integrating bids from multiple sources, including competing exchanges. Open Bidding is easier to configure and has lower latency than some header bidding alternatives, although many publishers continue to use header bidding exclusively or in combination with Open Bidding.[206] Among its advantages for publishers are simpler configuration and streamlined payments.[207] The introduction of Open Bidding also benefited some non-Google exchanges by reducing the

[205] Google, "Introduction to Open Bidding," Google Ad Manager Help (accessed Oct. 31, 2023), https://support.google.com/admanager/answer/7128453?hl=en("[B]efore a publisher can connect with an Open Bidding yield partner, the publisher must have an established contractual relationship with that partner.").

[206] For a comparison of Open Bidding and header bidding, see Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -440 to -441. For a comparison of timeouts, see Comms Doc, "RTB Timeouts" (Oct. 2019), GOOG-DOJ-15232606, at -609 ("Google's lower bid timeouts should have a slightly better user experience with lower latency"). For usage with header bidding, see Abhilasha, "The Ultimate Guide to Open Bidding for Publishers," headerbidding.co (Jul. 25, 2023), https://headerbidding.co/open-bidding-ultimate-guide/("[I]t is possible to run Open Bidding alongside Header Bidding."); George Levitte, "Improved header bidding support in Google Ad Manager," Google Ad Manager (Apr. 27, 2022), https://blog.google/products/admanager/improved-header-bidding-support-in-google-ad-manager/("[M]any [publishers use] a mix of header bidding and server-side solutions like Open Bidding").

[207] *See* Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Eliminate operational inefficiencies such as line item complexity […] Easy to set up, view/analyze reports and unified payments").

publishers' costs of integrating with them, allowing them to sell additional impressions.[208] For example, OpenX reported that "[e]xisting OpenX publisher partners who enabled [Open Bidding] through the OpenX Exchange experienced an average 48% increase in programmatic revenue from OpenX."[209] In Section XIII, I discuss in detail the benefits of Open Bidding for publishers and competing exchanges.

h) Unified First Price Auction and Unified Pricing Rules

121. As discussed in Section III.C.4 above, most exchanges transitioned to first-price auctions between 2017 and 2019.[210] Heterogeneity in the auction formats used by exchanges during this period complicated the implementation of header bidding and Open Bidding, both of which combine the results of auctions on different exchanges that may use different auction rules to sell the same impression. One unfortunate result of this "auction of auctions" process is that the bidder with the highest bid did not necessarily win the impression.

[208] *See* Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Easy to set up, view/analyze reports and unified payments […] Allows exchanges to respond to RTB call-outs […] Provides integrated reporting and billing for exchange bidding transactions won by 3rd party exchanges"), -441. *See also* Presentation, "Exchange Bidding Sell Side Update" (Jun. 14, 2018), GOOG-DOJ-11790760, at -775 (Table, [redacted]").

[209] OpenX, "Google & OpenX Release Study Showing Publisher Partners Experience 48% Revenue Lift Through Google Exchange Bidding Collaboration" (Feb. 15, 2018), https://www.openx.com/press-releases/google-openx-revenue-lift/.

[210] *See* Presentation, "DV360, Third Party Exchanges, and Outcome-Based Buying" (Oct. 16, 2018), GOOG-DOJ-12038253, at -267 ([redacted]. These figures would not include AdX's later transition to a first-price auction in 2019. *See also* Email from E. Lipkovitz to A. Pappu, "Re: Offering 1st price to publishers?" (Sep. 13, 2017) GOOG-DOJ-05272070, at -075 ("Other exchanges started the migration to 1st price auction recently arguing th[at] it is the best way to integrate it with HB.").

122. GAM transitioned to the **Unified First Price Auction (UFPA)** in 2019.[211] A Google employee described the reason for the transition to the first-price auction on GAM as follows:

> "Publishers typically use our platforms to work with a variety of demand sources, which used to compete under inconsistent rules, and passing through multiple intermediaries, each of which runs its own auction (some first-price, some second-price, and some apparently running strange hybrid mechanisms), potentially transforms bids, and collects a share of revenue. This led to market confusion and inefficiencies; the move to a unified first-price auction was an attempt to move to a simpler, more transparent and sustainable state, improving outcomes for publishers, advertisers, and other ecosystem participants. Of course, first-price auctions are not incentive-compatible, so this required both Google buyers and external buyers to modify bidding algorithms as well."[212]

Under the UFPA, all bidders—including AdX bidders, header bidders, and non-Google exchanges using Open Bidding—compete in the same first-price auction, with no so-called "last look." This change ensured that, for each impression, the winner in the UFPA would be the bidder with the highest bid. Google's buy-side tools implemented bid optimization programs on behalf of their advertiser customers to make it easier for them to bid optimally in the UFPA; there was no need for an advertiser to change its campaign

[211] Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/("[I]n the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 37.

[212] Email from [redacted] to [redacted], "Fwd: Join Auction Brown Bag Series: (TODAY @ 12pm PT!)" (Nov. 15, 2019), GOOG-DOJ-AT-00070433, at -433.

IV. GOOGLE ADS BIDDING PROGRAMS: PROMOTING SIMPLE BIDDING AND INCREASING SURPLUS FOR GOOGLE ADS ADVERTISERS

A. Overview

126. Since it started bidding on AdX in 2009,[217] Google Ads has updated its bidding program for the AdX auction several times, with each update designed to increase its profits and the surplus of its advertisers and to respond to changes in the strategies of publishers and other bidders. The following are the key evolutions:

a. Beginning before 2013, Google Ads submitted two bids for its advertisers in each AdX auction that were equal to the two highest values for the impression among its advertisers, adjusted for Google Ads' revenue share (hereinafter the "**two-bid policy**").[218] This two-bid policy was part of a simple, bidder-truthful auction for Google Ads advertisers.

b. In 2013, Google Ads introduced its **bid optimization** programs, **buy-side DRS** and later **Bernanke** to optimize its bidding on AdX and increase the value of impressions won by Google Ads advertisers.[219]

[217] Email from [redacted] to [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 19, 2009), GOOG-AT-MDL-010836318, at -318 to -319 (noting that "[t]he team has done a great job [with AdX 2.0 launch] […] to also go beyond in some important areas, e.g. […] Real Time Bidding, and of course integration with Adsense and Adwords.").

[218] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ("In this case, GDN first holds its own auction and submits the leading 2 bids to the AdX auction. Historically, GDN applied a 14% revshare to these bids and AdX applies a 20% sell-side revshare to all bids in their auction.").

[219] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 16, 2013), GOOG-DOJ-04306227, at -227 ("Today we launched GDN Dynamic Revshare - a means for GDN to optimize the revshare we apply to AdX bids."); Launch Details Spreadsheet, Launch 106307 (Aug. 29, 2023), GOOG-AT-MDL-009644018, at cells C1, C2 ("Launch Date [...] 2013-11-11").

c. A 2015 update, **Global Bernanke**, increased the value of impressions won by Google Ads advertisers further by allowing the revenue share collected by Google Ads to vary across different publishers' inventory.[220]

d. In 2019, as AdX replaced its second-price auction with its Unified First Price Auction, Google Ads updated Bernanke for the revised auction pricing rule and called the new program **Alchemist**.[221]

My analysis of data on Google Ads advertisers' values for impressions shows that each of these bid optimization programs increased advertiser surplus for most Google Ads advertisers.

127. Plaintiffs' allegations about Google Ads' bidding programs are marred by their misunderstanding of the operation of these programs. In particular:

[220] Email from [redacted] to [redacted], "[Caqengleads] [Launch 133445] Global Bernanke [redacted]" (May 21, 2015), GOOG-DOJ-15637938, at -938 ("Global Bernanke is an extension of project Bernanke in which GDN retains a 15% margin on AdX as a whole, while deviating from 15% on individual publishers.").

[221] Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -102 ([redacted]."); Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Google updated the Bernanke algorithms in 2019 to be compatible with the Unified First Price Auction. The updated version of Bernanke was sometimes referred to within Google as 'Alchemist.' The update was designed [redacted]").

137. Buy-side DRS worked as follows. Google Ads continued to submit two bids for each impression on AdX, but instead of determining the Google Ads high bid by deducting a fixed Google Ads revenue share from the highest scoring bidder's value, Google Ads deducted a *smaller* revenue share (as small as 0%) on some impressions.[246] This had the effect of increasing the Google Ads high bid on a subset of impressions, allowing its advertisers to win additional inventory. Google Ads continued to calculate advertiser payments based on the clearing price of the AdX auction, adjusted for the standard 14% revenue share, unless the result was higher than the advertiser's value for the impression, in which case the payment was capped at the bidder's value.[247, 248]

b) Project Bernanke: Winning More Impressions with a Fixed Average Revenue Share

138. In November 2013, Google Ads replaced buy-side DRS with a more comprehensive bid optimization program called **Project Bernanke**.[249] One of the motivations for Project Bernanke was to expand output by allowing Google Ads advertisers to purchase

Dynamic Revshare increases GDN revenue by [redacted] and profit by [redacted] on AdX inventory."); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -348, -350.

[246] Email from [redacted] to [redacted], "Re: GDN Dynamic Revshare launched today!" (Jan. 17, 2013), GOOG-DOJ-04306227, at -227 ([redacted]); Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -347.

[247] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under buy-side DRS, Google Ads would make a high bid of v_1 for some subset of impressions and a low bid of $0.86v_2$. On those impressions, if its high bid won the AdX auction, it would be charged $p = \max(0.86v_2, b_2)$ and would charge a winning Google Ads advertiser $\min(\max(b_2/0.86, v_2), v_1)$.

[248] *See* Design Doc, "Dynamic Revshare for AdWords on AdX" (Jul. 13, 2012), GOOG-DOJ-13605152, at -153; Presentation, "GDN Dynamic Revshare Launch" (Jan. 16, 2013), GOOG-DOJ-02854344, at -349.

[249] Launch Details Spreadsheet, Launch 106307 (Aug. 29, 2023), GOOG-AT-MDL-009644018, at cells C1, C2 ("Launch Date [...] 2013-11-11").

otherwise unsold impressions, which was around half of all impressions at the time Bernanke was introduced.[250] At a high level, Bernanke achieved this objective by reducing the price that Google Ads paid for some impressions, allowing it to use the savings to bid more on other impressions, thus winning additional impressions for its advertisers and reducing the number of unsold impressions on AdX.[251] Project Bernanke accomplished this by modifying *both* of the bids that Google Ads submitted into the AdX second-price auction: it increased its high bid to win more impressions (as in buy-side DRS), but also decreased its low bid to reduce the AdX clearing price on some impressions.[252] Like buy-side DRS, Bernanke caused the Google Ads revenue share to vary on individual impressions, but Google Ads calibrated Bernanke to ensure that its overall revenue share remained at the 14% target.[253]

139. Project Bernanke used an optimization procedure to determine its bidding strategy into AdX. Under Project Bernanke, Google Ads chose **multipliers** for its two bids into AdX. The **high bid multiplier** led to high bids that were *higher* than those that Google Ads used under the two-bid policy, causing Google Ads advertisers to win additional impressions and reduce the number of unmatched impressions, increasing the publisher's

[250] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("[redacted]").

[251] Email from [redacted] to W. Kim, "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787 ("GDN wins more auctions and generates more revenue at the same average 14% revshare; GDN's advertisers win more auctions and get greater click/conversion volume; and AdX publishers enjoy higher match rate and revenue.").

[252] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("Project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout (e.g. GDN margin remains constant) and GDN profit is maximized.").

[253] Email from [redacted] to W. Kim, "[Launch 106307] gTrade: Project Bernanke" (Oct. 18, 2013), GOOG-DOJ-14952787, at -787 ("GDN wins more auctions and generates more revenue at the same average 14% revshare.").

revenue from those impressions and ones for which that bid was second-highest.[254] The **low bid multiplier** led to low bids that were *lower* than those that Google Ads used under the two-bid policy, lowering the AdX clearing price of certain impressions, namely, ones for which Google Ads would otherwise have submitted the two highest bids and both of those exceeded the auction's floor price.[255] The high and low bid adjustments were chosen separately for each publisher to *maximize* the total dollar value of impressions purchased via Google Ads while maintaining an overall Google Ads revenue share target (typically 14%), given the payment rules for Google Ads advertisers.[256]

140. [redacted]

[254] [redacted]; Presentation, "Project Bernanke: Quantitative Easing on the AdExchange" (Oct. 21, 2013), GOOG-DOJ-12700489, at -493 ("[redacted]").

[255] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 to -176 ("As mentioned above, project Bernanke involves reducing the second price and increasing the first price of the two bids submitted by GDN to the AdX auction in such a way that publishers receive fair payout and GDN profit is maximized.").

[256] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -175 ("This is done in such a way that GDN profit is maximized while also ensuring fair GDN payout to the exchange/ publisher. [redacted]").

[257] "Bernanke experiment analysis" (Sep. 3, 2013), GOOG-DOJ-13469175, at -176 ("[redacted]…").

[redacted].[258] Google Ads also introduced an "online safety mechanism" to adjust the multiplier chosen in the case its overall revenue share drifted too far from the target.[259] Initially, the Google Ads revenue share target was applied per publisher.[260] In August 2015, Google Ads launched **Global Bernanke**, which applied the Google Ads revenue share target on average across publishers, while allowing the Google Ads revenue share target to vary to an extent for individual publishers.[261, 262] This additional flexibility in the choice of bid multipliers allowed Google Ads to further increase the total value of impressions won by its advertisers.

141. The optimization procedures described in Paragraph 140 used information of a kind that was also available to other buying tools. Contrary to the characterization by Plaintiffs, Google Ads did not "[rely] on inside information [...] using publishers' unencrypted ad

[258] [redacted].

[259] Presentation, "Project Bernanke: Quantitative Easing on the AdExchange" (Oct. 21, 2013), GOOG-DOJ-12700489, at -492 ("[redacted]").

[260] Presentation, "Project Bernanke: Exchange Profit Optimization" (May 20, 2013), GOOG-DOJ-13625417, at -422 ("14% margin across all pubs or per pub? We suggest per pub. Ensures 'fair' payout to each pub").

[261] Launch Details Spreadsheet, Launch 133445 (Aug. 25, 2023), GOOG-AT-MDL-009644112, at cells C2 (noting launch date of 2015-8-12), D2 ("Global Bernanke is an extension of project Bernanke in which GDN retains a 15% margin on AdX as a whole, while deviating from 15% on individual publishers.").

[262] At the same time, Google Ads updated the Bernanke objective function from total dollar value of impressions won by Google Ads to the total value in terms of conversions for advertisers. *See* Presentation, "Beyond Bernanke" (Aug. 17, 2015), GOOG-DOJ-28385887, at -894 ("Global Bernanke solves slightly modified optimization problem: **Maximize** Buy-side **value** (RPM [revenue per mille] * **CPD** [conversions per dollar] * Queries) per day" [emphasis in original]).

incentive for advertisers to earn additional surplus on the extra impressions transacted by reducing their bids into Google Ads below their values.

143. In April 2016, Google Ads changed the Bernanke pricing rule for the majority of its advertisers (those using its automated bidding tools) to restore bidder-truthfulness.[267] It did so by charging a winning advertiser its threshold price—that is, an amount equal to the lowest value it could have reported while still winning the impression.[268] This resulted in a bidder-truthful process for Google Ads advertisers, making it simpler for them to configure their campaigns optimally.

c) Alchemist: Updating Bernanke to Optimize Bids for Advertisers in the Unified First Price Auction

144. In September 2019, when AdX completed its transition to the Unified First Price Auction, Bernanke was updated to be compatible with the first-price auction format.[269] The updated program was called **Alchemist**. As I discussed in Section III.C.3.b, in the first-price auction format, it is optimal for a profit-maximizing bidder to shade its bid below its value. Alchemist shades bids into AdX on behalf of advertisers using Google

[267] [redacted].

[268] To formalize this mathematically, suppose that v_1 and v_2 are the largest and second-largest values among Google Ads advertisers, and let b_2 be the larger of the second-highest bid on AdX and the floor price on AdX. Under Bernanke, Google's high bid was βv_1 (for some $\beta \geq 0.86$) and its low bid was αv_2 (with $\alpha \leq 0.86$). If Google Ads won the AdX auction, it would pay AdX $\max(b_2, \alpha v_2)$, and, under Bernanke with the threshold pricing rule, the winning Google Ads advertiser would be charged $\max(b_2/\beta, v_2)$.

[269] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Google updated the Bernanke algorithms in 2019 to be compatible with the Unified First Price Auction. The updated version of Bernanke was sometimes referred to within Google as 'Alchemist.'").

Ads. Those bids determine the prices paid by AdX to publishers, but Alchemist charges a winning advertiser its threshold price, which makes the auction process bidder-truthful for advertisers.[270] Like the earlier versions of Bernanke, Alchemist chooses Google Ads' bids in the AdX auction to maximize the total value of impressions won by Google Ads advertisers, subject to maintaining Google Ads' average revenue share and its threshold pricing rule for advertisers.[271] Unlike the original versions of Bernanke, Alchemist optimizes bids for a first-price auction format, rather than a second-price format, determining the optimal bids into the Unified First-Price Auction using experiments similar to those conducted by DV360 in the Poirot program, discussed in detail in Section VII below.[272] This means that under Alchemist, Google Ads shoulders the task of optimizing bids for the first-price auction format—a task that advertisers would otherwise need to attempt to do on their own—while eliminating any need for advertisers to strategize about their reporting to Google Ads.

2. Google Ads' Bid Optimization Programs Benefited Its Advertisers

145. In this section, I establish that each of Google Ads' bid optimization programs increased advertiser surplus for most of Google Ads' advertiser-customers, compared to their

[270] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22 ("Since Google has transitioned to a Unified First Price Auction, the amount an advertiser pays Google Ads has been determined in generally the same way as before the transition, except that Google Ads began to use minimum-bid-to-win data to determine the amount that the advertiser would need to bid to win the AdX auction (factoring in the Google Ads margin).").

[271] Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -102 ([redacted]).

[272] Design Doc, "GDN AdX First-Price Bidding Infrastructure" (Sep. 3, 2019), GOOG-DOJ-15254730, at -735 ([redacted]).

VI. PROJECT ELMO: MANAGING ADVERTISER BUDGETS WHILE DISINCENTIVIZING BID DUPLICATION AND MULTI-CALLING

A. Overview

195. Project Elmo is a budget management feature introduced by DV360 in November 2017[383] and Google Ads in November 2018.[384] Elmo ensures that Google's buy-side tools make consistent bids on behalf of an advertiser across all bid requests received for a given end user (as identified by a cookie) within each minute.[385] By bidding consistently on behalf of an advertiser for the same end user within each minute, Elmo helps advertisers control their bidding strategy and their rates of spending—for example, to avoid rapid depletion of their advertising budgets—and disincentives the harmful practices of multi-calling and bid duplication by publishers and exchanges.

196. Plaintiffs allege that Elmo was a strategy "to reduce spend on rival exchanges[,] represent[ing] a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand."[386] In fact, Elmo was designed to ensure

[383] Launch Details Spreadsheet, [redacted] (Aug. 29, 2023), GOOG-AT-MDL-009644201, at cells C1, C4 ("Launch Date [...] 2017-11-29").

[384] Email from [redacted], "[redacted] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-AT-MDL-015521456, at -456 ("Launch Date [...] 2018-11-19"). *See also* Email from [redacted], "[redacted] Cookie-based budget throttling for GDN advertisers" (Dec. 6, 2018), GOOG-DOJ-AT-01363996, at -996 (noting that launch had occurred).

[385] Email from [redacted], "[Launch 201914] DBM advertiser experiment for cookie-based throttling" (Aug. 29, 2017), GOOG-DOJ-13564564, at -564 ("[redacted]."); Design Document, "Cookie Budget Throttling" (Apr. 19, 2017), GOOG-DOJ-AT-02472888, at -889 ("[redacted]").

[386] Fourth Amended Complaint ¶ 405 ("Taken together, Poirot, Elmo, and other strategies to reduce spend on rival exchanges represent a campaign to undermine the success of header bidding and starve rival exchanges of their primary source of demand.").

VIII. DYNAMIC ALLOCATION: USING AUCTIONS TO INCREASE PUBLISHER REVENUES ON REMNANT IMPRESSIONS

A. Overview

261. Dynamic Allocation (DA) was an auction design introduced by DoubleClick in 2007 to improve publishers' sales of remnant impressions.[507] At the time of its launch, DA differed from the dominant payment models of ad networks and the waterfall—a common method used by publishers to allocate remnant impressions—in its use of a second-price auction to determine payments to publishers.[508] Under DA, a publisher could configure DFP to sell a non-guaranteed impression to a bidder on AdX only when it would pay more than the publisher's largest expected payment from any other remnant demand source.[509]

262. As a consequence, on every impression, DA could only increase a publisher's expected revenues compared to a *status quo ante* without bids from AdX. To quantify the effects of DA for publishers and evaluate these effects relative to a wider range of counterfactuals, I conducted a simulation study using GAM and Google Ads auction data from January of 2024. The simulations suggest that average publisher revenues using DA are substantially higher than those obtained using a waterfall, both in the case that AdX is not included in

[507] *See* Presentation, "2008 Strategic Planning DoubleClick Advertising Exchange" (Jul. 26, 2008), GOOG-TEX-00458239, at -247; Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -843.

[508] *See* White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -413 to -414.

[509] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -414 ("If [AdX] can provide the publisher with a net CPM value higher than they would have gotten from delivering their directly booked, non-guaranteed ad, [AdX] will deliver an ad.").

266. In a waterfall, if a publisher does not know which demand sources are interested in purchasing any particular impression but knows exactly the prices each interested source would pay, then it can maximize its revenue by ordering the waterfall list from the highest price offer to the lowest. But when the prices from different demand sources are not known, for example because they are set by separate auctions within each ad network, then no waterfall process can guarantee selling to the highest bidder: the publisher cannot know whether another buyer lower on its list would have bid more. With uncertainty about price offers, the publisher is incentivized to reject some bids from demand sources near the top of the waterfall, even if the same bids would be accepted from sources near the bottom of the waterfall. The publisher can implement that policy by setting *higher* minimum prices nearer the top of the waterfall.

267. Even so, by offering each impression *sequentially* to ad networks, the waterfall procedure could leave value on the table. Under the waterfall, an impression might be assigned to an advertiser on Ad Network A with a lower value for the impression than an advertiser on Ad Network B, merely because Ad Network A had a higher priority in the publisher's waterfall. That was in large part because, at that time, the prevailing technology did not permit an efficient "real-time" auction among different demand sources. Publisher revenue and advertiser surplus could *both* increase by reallocating the impression to the advertiser on Ad Network B at some higher price than Ad Network A paid, if the technological limitations that existed at the time could be overcome and standards for interoperability could be established.

C. DA Introduced Auctions for Impressions, Improving Platform Thickness and Increasing Publisher Revenues

268. **Dynamic Allocation**, introduced in 2007,[525] improved the allocation by replacing the *sequential* logic of the waterfall with the *simultaneous* comparison of bids from advertisers, ad agencies and ad networks participating in a real-time auction on AdX. In the version of AdX that existed when DA was introduced, participating demand sources would enter bids in advance of auctions, with each bid containing targeting criteria that told AdX the types of impressions that the demand source was interested in purchasing at the specified bid amount.[526] In DFP, publishers would codify information about their non-AdX sources of remnant demand using non-guaranteed line items, which also contained targeting criteria and a **value CPM** (also known as a **static bid**), which DFP used to represent that source of demand in the DA process.[527]

269. DA used a two-step procedure to allocate remnant impressions. First, it would identify the eligible non-guaranteed line item with the highest value CPM: Google engineers called this static bid the **DFP booked price**.[528] Then, AdX would run a second-price

[525] Presentation, "2008 Strategic Planning DoubleClick Advertising Exchange" (Jul. 26, 2008), GOOG-TEX-00458239, at -247 ("Q3'07 Dynamic Allocation.").

[526] DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136 ("Buyers can bid on ad slot inventory by indicating their preferred targeting elements and specifying an associated CPM based bid.").

[527] In the original version of AdX, prior to the acquisition by Google, the terminology was a little different: line items were just 'ads' and value CPMs were just 'bids,' but to avoid confusion with other places in this report, I will adopt Google's terminology. *See* DoubleClick, "Ad Selection Specifications for Ad Server Version 14.1" (Mar. 27, 2007), GOOG-AT-MDL-007374059, at -136; DoubleClick for Publishers, "Terminology differences with DART," DoubleClick for Publishers Help (captured on Feb. 11, 2012), https://web.archive.org/web/20120211164005/http://support.google.com/dfp_premium/bin/answer.py?hl=en&answer=158833.

[528] Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -843 to -854; Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶¶ 10-12.

auction using the bids it received from advertisers on AdX with a floor price at least as high as the DFP booked price.[529] The AdX bidder with the highest bid would be allocated the impression, as long as that bid was above the floor price; otherwise, the impression was allocated to the demand source associated with the best non-guaranteed line item. If that demand source had no ad to serve, it might pass the impression back to other demand sources in a waterfall. DA was backward compatible: a publisher could adopt DA without major changes to its existing relationships with ad networks.

270. By using a second-price auction to allocate impressions, DA eliminated the possibility of inefficient allocation among the bidders in the auction and ensured that the publisher received a price for the impression that no other AdX bidder was willing to beat. But DA had another important feature in its design in recognition of the fact that publishers had other potential demand sources for their remnant impressions: a floor price in the form of a value CPM set by the publisher.[530] A publisher would be incentivized to set those value CPMs so that the effective floor price for each impression was at least as large as the expected revenue from any non-AdX demand source, ensuring that a bidder on AdX could win only if it paid at least that amount. As long as the publisher did so, DA could increase the expected revenue to the publisher from each impression it sold, but could never reduce it.

[529] If the publisher had otherwise set a floor price for the impression that was higher than the DFP booked price, that floor price would apply. *See* "Adx Queries by Pricing Rule" (Sep. 1, 2016), GOOG-DOJ-13470118, at -118 ("For every query in adx, the price can be determined by the following: [...] PUBLISHER_RESERVE: the reserve set by the publishers[.]").

[530] As Professor Weinberg notes, in addition to using value CPMs, publishers set an explicit floor for AdX; when describing how DA works he writes: "Every lower priority static line item, including AdX, has [...] a price floor [...] DFP calls AdX with reserve price equal to the maximum of [the reserve derived from value CPMs] and AdX's price floor." Expert Report of M. Weinberg (Jun. 7, 2024) at ¶ 113. It is not important for my analysis which mechanism publishers use to set the binding floor prices.

Moreover, the second-price auction ensured that, on each impression won by AdX bidders, the winning bidder paid *only* the amount needed to beat other bids on AdX and the floor price determined by the publisher, and not more, which as I explained before, made bidding simpler for advertisers (see Section III.C.3.a).

D. Real-Time Bidding in AdX 2.0 Further Increased Benefits of DA for Publishers and Advertisers on AdX

273. In September 2009, after its acquisition of DoubleClick, Google redesigned the AdX exchange to further increase the benefits of online display advertising auctions for publishers and advertisers. The redesigned **AdX 2.0** incorporated **real-time bidding** from bidders on AdX and Google's buy-side products (originally just AdWords, but later also DV360).[533] Under real-time bidding, AdX would calculate real-time bids from Google's buy-side products and send a **bid request** containing information about the impression to non-Google bidders on AdX (later called **Authorized Buyers**). After receiving a bid request, bidders would use real-time information (such as ad campaign information and cookies) to determine their bids for the impression, which they would send to AdX.[534]

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https://www.forbes.com/2008/04/08/online-ad-networks-tech-cx_pco_0408paidcontent.html?sh=7414ef02cb8e ("All ad networks are not created equal: If all sides can agree on one thing, it's the need for greater clarity to what's being sold and where it's being placed. […] 'Both buyer and seller require transparency. In a lot of cases [in terms of ad nets' handling of remnant, or unsold ad inventory], the buyer doesn't really know what they're getting. And the seller doesn't have any control over price.'").

[533] Email from [redacted] to [redacted], "Re: [Adsense-eng-wat] [Adsense-eng] Re: [Ads-engdirs] Doubleclick Ad Exchange 2.0 - Launched!" (Sep. 18, 2009), GOOG-AT-MDL-010836318, at -318 ("I am extremely thrilled to see AdX 2.0 launch. The team has done a great job not only getting to parity with AdX 1.0 but to also go beyond in some very important areas, e.g. API support, Real Time Bidding, and of course integration with Adsense and Adwords.").

[534] Maciej Zawadziński, "How Does Real-Time Bidding (RTB) Work?," Clearcode Blog (Jul. 2, 2021), https://clearcode.cc/blog/real-time-bidding/ ("The supply-side platform analyzes the information about the user (location, web history, and, if available, age, gender and any other user information) and then sends this information to the ad exchange. Once the ad exchange receives this information, it connects to the demand-side platforms and relays information about the user. The ad exchange starts an auction, and the DSPs then bid on the impression based on what that particular impression is worth to them -determined by predefined parameters set by the advertisers.").

AdX would then run an auction using those bids and return any winning ad to DFP, which served code for the winning ad to the publisher's website. This entire process—from the arrival of the impression to the collection and processing of bids and the presentation of any winning ad—would be completed in the blink of an eye,[535] avoiding slow page load times for end users. Initial reactions from industry players to the launch of AdX 2.0 heralded it as a "watershed moment in the progression towards truly dynamic, demand-driven advertising transactions" and a "positive event for anyone in the exchange space."[536]

274. Real-time bidding improved publisher revenues and the matching of impressions to advertisers. Static bids could leave value on the table for both publishers and advertisers: an advertiser might be willing to pay much more for an impression about which it had accurate real-time information (for example, whether the user had recently visited its website) than it might offer using static bids determined without real-time information. Real-time bidding also allowed a bidder to develop its own methods for determining bids, using any additional information the bidder might have about the impression that it was unable to incorporate into any static bidding system. For this reason, real-time bidding offered potential benefits to both publishers and advertisers.

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[535] Google, "How Authorized Buyers Work With Google Ad Manager," Google Ad Manager Resources (accessed Sep. 27, 2023), https://admanager.google.com/home/resources/how_authorized_buyers_work_with_google/ ("This all happens within around 100 milliseconds.").

[536] Email from S. Spencer to [redacted] "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -113 ("I think everyone is excited to see how [Google] can apply their expertise to the next generation of biddable display."), -113 ("The rollout of Google's updated DoubleClick Exchange offering - and the proliferation of other similar real time bidding platforms - marks a watershed moment in the progression towards truly dynamic, demand-driven advertising transactions."), -112 ("I think the launch of AdX 2.0 is an example of growing the pie as opposed to stealing share from a competitor because it's going to bring lots of new sellers (AdSense and DART for Publisher sites) and buyers (anyone who uses AdWords) into the market. As those sellers and buyers get comfortable with the exchange model I think they'll begin trading on the other platforms as well, so I think this is a positive event for anyone in the exchange space.")

impression, which would always win the auction over the static bid of $1 from Network X. After real-time bidding is enabled, the AdX bidder would only win impressions when it had the higher value of $1.50 (three quarters of the time). In that case, Network X—the network without real-time bidding—would benefit from the transition to real-time bidding, because it would win the impression in the one quarter of cases when the AdX bidder has a value of 70¢. The publisher can also benefit from the transition to real-time bidding in this example by increasing its floor price in the AdX auction above $1.00, extracting more revenues from the AdX bidder when it has a high value for the impression.

277. The preceding examples understate the benefits of DA to publishers since, for simplicity, I have assumed there is only one bidder on AdX. In more realistic examples with multiple AdX bidders, the benefits to publishers would be higher because the AdX winner's price would be the maximum of the floor price and the second-highest bid.

278. To realize the benefits of real-time bidding when many ad networks offered fixed-price payments or revenue sharing to publishers, ad servers needed to adapt their allocation methods to integrate both approaches—a process that was widely understood in the industry to be challenging. OpenX cofounder Jason Fairchild summarized the challenge of unifying live and static demand, saying, "If you think about it, they're two fundamentally different marketplaces. To combine them, you have to rethink even your auction mechanism […] Everything is radically different."[541] DA with AdX 2.0, launched

[541] Josh Ong, "Adtech firm OpenX unveils an industry-changing fusion of real-time bidding and ad networks," The Next Web News (Jun. 9, 2014), https://thenextweb.com/news/adtech-firm-openx-unveils-industry-changing-fusion-real-time-bidding-ad-networks.

in 2009, was Google's answer to this challenge, and other competing exchanges introduced real-time bidding at around the same time.[542]

279. DA with real-time bidding on AdX was an important innovation offering large benefits for publishers. A Google experiment from 2010 found that [redacted][543] On average, the experiment found that [redacted].[544] In 2013, Google estimated that DA increased publisher revenues [redacted][545] Even so, publishers could have, if they wished, disabled real-time bidding from AdX to restore their pre-DA configurations.[546]

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[542] *See* Mike Nolet, "RTB Part II: Supply supply supply!," Mike On Ads (Sep. 19, 2009). http://www.mikeonads.com/2009/09/19/rtb-part-ii-supply-supply-supply/ ("Over the past few months pretty much any aggregator of supply has launched, announced or started work on some sort of RTB capability. All major exchanges — Yahoo's Right Media, Microsoft's AdECN and Google's AdEx have RTB integrations in the works. Of the pub aggregators, AdMeld & PubMatic are live and Rubicon is actively working on a solution. As mentioned, FAN has been live with Myspace inventory for a while and there are a number of other parties, such as ContextWeb, AdBrite and OpenX, entering the space.").

[543] White Paper, "DoubleClick Ad Exchange Impact" (Q4 2010), GOOG-DOJ-13247322, at -322 ("[redacted]").

[544] White Paper, "DoubleClick Ad Exchange Impact" (Q4 2010), GOOG-DOJ-13247322, at -322 ("A[redacted]").

[545] Presentation, "Ad Exchange Dynamic Allocation" (Sep. 5, 2013), GOOG-TEX-00054839, at -844 ("[redacted]").

[546] *See, e.g.*, Summer Livestream Series (Sep. 2019), GOOG-AT-MDL-B-004582905, at -3162 ("You can still exclude specific ad units from dynamic allocation if desired"); Draft Help Center Doc, "DFP and dynamic allocation" (Nov. 16, 2013), GOOG-DOJ-15416614, at -614 ("Dynamic allocation [...] allows Ad Exchange to compete in real time with line items booked in DFP. [...] Publishers configure settings in DFP and Ad Exchange in order to control which inventory is eligible to compete, and how."). Even though I am not aware of earlier references to disabling DA on DFP, it would always be possible for publishers to effectively disable DA—while still using DFP

see Paragraph 275).[567] Compared to the *status quo ante*, DA allowed real-time competition among advertisers, and according to Google's analysis, [redacted].[568]

296. *Second,* in the period that followed the introduction of DA, incorporating real-time bids from additional indirect demand channels would still have required further technological progress, including agreements on applicable industry standards. When DA was introduced, ad exchanges were still nascent and the technology standard for real-time bidding had not yet been developed,[569] as Plaintiffs' experts have acknowledged.[570] At that time, industry participants viewed the main challenge not as exchange interoperability but "driving adoption" and having "sellers and buyers get comfortable with the exchange model."[571] DA eased this transition as it did not displace existing deals

[567] Suppose the average historical revenue from the best demand source is given by *H* and that the publisher sets a Value CPM, *V* >= *H*, for that demand. After DA, in the case where AdX clears *V*, the publisher must receive at least *H*. In the case where AdX does not clear *V*, the impression is allocated to the best alternative demand source, where the publisher receives at least *H* in expectation. In both cases, the publisher earns at least as much as they were earning before. Professor Weinberg acknowledges this outcome, noting that "[w]hen all other demand sources are static, Dynamic Allocation simply gives the publisher a shot at additional revenue." Expert Report of M. Weinberg (Jun. 7, 2024), at ¶ 112.

[568] White Paper, "Profiting from Non-Guaranteed Advertising: The Value of Dynamic Allocation & Auction Pricing for Online Publishers" (2010), GOOG-DOJ-06818412, at -415 ([redacted]).

[569] Efforts to develop a standard began in November 2010 with the launch of the OpenRTB Consortium. *See* IAB Tech Lab, "OpenRTB" (Jul. 27, 2020), https://iabtechlab.com/standards/openrtb/ ("The Real-Time Bidding (RTB) Project, formerly known as the OpenRTB Consortium, assembled by technology leaders from both the Supply and Demand sides in November 2010 to develop a new API specification for companies interested in an open protocol for the automated trading of digital media across a broader range of platforms, devices, and advertising solutions.").

[570] *See* Expert Report of J. Gans (June 07, 2024), at ¶ 557 ("At the time that DoubleClick developed DA, the demand sources in the Waterfall were networks. Rather than running a real-time bidding auction and returning a live bid, networks simply purchased or did not purchase the impression when called in the Waterfall.").

[571] Email from S. Spencer to [redacted], "FW: comments from industry players on AdX 2.0 on AdExchanger.com this evening" (Sep. 22, 2009), GOOG-AT-MDL-B-003180112, at -114 ("Regarding concerns, the biggest challenge for any exchange is driving adoption. It's not always as simple as 'if you build it, they will come'. The exchange represents a rather significant shift in how we typically transact, so adjusting to that for both buyer & seller takes some time."), -112 ("I think the launch of AdX 2.0 is an example of growing the pie as opposed to stealing share from a competitor because it's going to bring lots of new sellers (AdSense and DART for Publisher sites) and buyers (anyone who uses AdWords) into the market. As those sellers and buyers get comfortable with the

between publishers and remnant demand (including demand called by the waterfall), and this backward compatibility made it easy for publishers to adopt. Publishers could also disable DA if they decided it was not to their benefit.[572]

297. If it were even technically possible (which Plaintiffs' experts have not shown), implementing any unified auction in 2007 would also have been a significant organizational challenge, requiring demand sources to coordinate, agree on standards, and coordinate the times of implementation.[573] Such a process would have delayed the transition to a new ad allocation process. Redesigning Google's online display advertising platform to accept bids from other exchanges presented challenges, including the need to integrate bids in different auction formats, to avoid self-competition for bidders bidding on multiple exchanges, and to avoid price-fishing tactics by publishers. Responding to these challenges necessitated further innovations, as I discuss in Section XIII.

298. *Third,* Professor Gans claims that "DA allowed AdX, and only AdX, to compete in real-time against all non-guaranteed inventory, which was priced at a historical, average price, not a live auction price,"[574] but as Plaintiffs' experts and industry media

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exchange model I think they'll begin trading on the other platforms as well, so I think this is a positive event for anyone in the exchange space.").

[572] *See, e.g.*, Summer Livestream Series (Sep. 2019), GOOG-AT-MDL-B-004582905, at -3162 ("You can still exclude specific ad units from dynamic allocation if desired."); "DFP and dynamic allocation" (Nov. 16, 2013), GOOG-DOJ-15416614, at -614 ("Publishers configure settings in DFP and Ad Exchange in order to control which inventory is eligible to compete, and how.").

[573] Efforts to develop a standard began in November 2010 with the launch of the OpenRTB Consortium, and support for header bidding was added to the OpenRTB standard in version 2.5, which was adopted in December 2016. *See* IAB Tech Lab, "OpenRTB" (Jul. 27, 2020), https://iabtechlab.com/standards/openrtb/ ("The Real-Time Bidding (RTB) Project, formerly known as the OpenRTB Consortium, assembled by technology leaders from both the Supply and Demand sides in November 2010 to develop a new API specification for companies interested in an open protocol for the automated trading of digital media across a broader range of platforms, devices, and advertising solutions. […] Open RTB 2.5 […] Release highlights include: […] Header Bidding Support - allowing for a signal when a bid request is originated from an upstream decisioning implementation like header bidding").

[574] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 568.

competition in the ad exchange market" and dismisses Google's reasons for the limits as "pretextual,"[673] the documents he relies upon undermine his opinion and suggest that Google had legitimate technical reasons to protect its systems from the strain caused by publisher configurations with unusually many line items.

B. How the So-Called "Last Look" Arose As a Consequence of Some Publishers' Configuration of Header Bidding in GAM

356. **Header bidding** is a technology that allows publishers to request and compare real-time bids from multiple demand sources simultaneously.[674] It began to gain popularity around 2014,[675] years after Dynamic Allocation launched, as a way for publishers to incorporate real-time bids from multiple exchanges.[676] Publishers typically implemented header bidding through snippets of code (in the header of the web page) that sent bid requests from the end user's browser to ad exchanges.[677] Header bidding can be described as an

[673] *See* Expert Report of J. Gans (Jun. 7, 2024), at ¶ 646 ("Google's motive in imposing limits to the number of line items available to publishers, and denying requests for those limits to be raised, was to restrict competition in the ad exchange market by making Header Bidding more difficult and costly to the largest and most important publishers. While Google offered various technical explanations for the caps, these were pretextual.").

[674] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("When a user visits the publisher's site, the browser calls participating ad exchanges or other demand partners (either directly or via a header bidding server) to submit bids, and runs an auction between those bids before Google's ad server is called.").

[675] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("Around 2014, web publishers began to adopt Header Bidding."). *See also* AdPushup, "Header Bidding" (2023), https://www.adpushup.com/header-bidding-guide/ ("Header bidding made it to ad tech somewhere around 2014. And only after one year, in 2015, the technique went viral.").

[676] [redacted].

[677] My understanding of the configuration of header bidding in DFP is based on Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -338 to -339.

auction of auctions because demand sources would typically determine their bids using an internal auction before participating in the header bidding first-price auction.[678]

357. As described in Section III.D.3.f, header bidding could directly allocate the impression to the highest bidding exchange,[679] but, for the reasons I discuss in Section X.C below, many publishers sought to integrate header bidding with Google's ad server.[680] Because line items in DFP were not designed to accept real-time bids from non-Google exchanges,[681] these publishers used non-guaranteed line items—originally intended to represent static bids from ad networks—to instead represent real-time bids from non-Google exchanges.[682] To accomplish that, a publisher would configure its header bidding code to select a non-guaranteed line item with an accompanying value CPM in Google's ad server. These value CPMs could be chosen freely by the publisher and, importantly, could differ from the winning header bid. Prebid.js, one of the leading header bidding tools,

[678] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 13 ("These Header Bidding auctions are typically first-price auctions."). *See also* Prebid.org, "Prebid.js FAQ" (accessed Dec. 1, 2023), https://docs.prebid.org/dev-docs/faq.html ("Header Bidding is a first-price auction").

[679] *See* Prebid.org, "Running Prebid.js without an ad server" (accessed Sep. 7, 2023), https://docs.prebid.org/dev-docs/examples/no-adserver.html ("This example demonstrates running [a header bidding] auction and rendering without an ad server.").

[680] *See* Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -939 ("[redacted]").

[681] Deposition of S. Spencer at 71:18-21 (Aug. 12, 2021), GOOG-AT-MDL-007178292, at -363 ("So in the original design of the system, it was not designed to put exchanges in as line items. Line items are designed to represent direct deals or network deals."); Deposition of [redacted] at 50:8-20 (Nov. 6, 2020), GOOG-AT-MDL-007172126, at -176 ("The way the system was built is that line items were always intended to be reservations. There wasn't a concept of using them for realtime pricing. And so we had in mind that publishers would have, you know, possibly thousands of line items and the system was built to scale to that, but with using line items for realtime pricing, which is not what they were designed to be used for, there were ten, sometimes ten times, sometimes 100 times, sometimes 1,000 times more line items than the system was designed to support.").

[682] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 14 ("Up until at least December 2021, the winning bid from the Header Bidding auction was typically used to trigger a specific line item that the publisher had booked within Google's ad server (most commonly a remnant line item), and […] the Value CPM of that line item could represent the winning Header Bidding bid as a floor in the AdX auction (prior to September 2019) or as a competing bid in the Unified First Price Auction (from September 2019 onwards).").

contains an inbuilt feature to adjust header bids before they are sent to the ad server, with Pubstack, a supply-side tool, detailing how the feature could be used to "giv[e] Prebid an edge in the competition against GAM" by inflating header bids.[683] The actual header bids are never observed by GAM or bidders on AdX. GAM would use the value CPM of the header bidding line item in its ad selection process (including DA and EDA). As a result, the highest bid from an AdX bidder would win the impression only if it exceeded the highest value CPM associated with header bidding line items and any other floor prices that might apply to the impression. If there was no such higher AdX bid and the header bidding line item had the highest value CPM among all the other line items, the impression would be allocated to the winning header bidder.

358. In each auction, AdX bidders are informed of the highest floor price applying to that impression.[684] Because a header bidding line item sometimes determines the auction's floor price, critics have sometimes described AdX as having had a "last look" over header bids.[685] However, as just described and in further detail in Section X.D.1 below, the resulting floor price need not be *equal to* the winning header bid. In fact, publishers had an incentive to, and often did, set the floor price *higher than* the winning header bid,

[683] Asmaâ Bentahar, "Bid Adjustments Simplified: Run Fair Auctions with no Hassle," Pubstack (May 2, 2021), https://www.pubstack.io/topics/bid-adjustments-simplified ("Alternatively, this next one will slightly increase all returned CPMs, giving Prebid an edge in the competition against GAM").

[684] Before 2016, Authorized Buyers (then "AdX buyers") could only see the highest floor price among the "rule" floor prices set by the publisher and any floor price determined by RPO, but since 2016, all bidders see the highest among all the floor prices, including those determined by the value CPMs of remnant line items. *See* Launch Doc, "Including Third-Party Threshold in the Revealed Reserve Prices to AdX Buyers" (Aug. 9, 2016), GOOG-DOJ-13208800, at -800 ("[redacted]").

[685] Presentation, "Changes to Ad Manager auction" (Jan. 10, 2019), GOOG-DOJ-10924270, at -273 ("AdX and EB have visibility into remnant price before they submit bids (commonly referred to in market as 'last look')").

438. These debt accounts worked to maintain the average revenue share as follows.

439. On some impressions for which the highest bid was in the dynamic region, DRS v2 would decrease the AdX revenue share to ensure the impression would sell. Rather than charging each winning buyer its bid on those impressions with a discounted revenue share, DRS v2 charged each winning buyer an amount between its bid and the publisher's chosen floor price. AdX would then add a "debt" to the buyer's debt account, equal to the "discount" it had applied to the buyer's bid to allow that impression to transact, which is the amount that the buyer would need to raise its bid to win with the standard per-impression revenue share.[869] AdX would also add a "debt" to the publisher's debt account equal to its "discount" on the AdX revenue share, the amount that its floor price would need to be lowered in order to sell the impression with the standard per-impression revenue share.[870]

440. On some impressions for which the highest bid was above the amount required to win the impression in the absence of DRS, AdX would collect its standard revenue share plus an additional payment to recoup debts previously accrued by publishers and advertisers under DRS v2.[871] It did so while still charging the winning buyer a total amount less than its bid and paying the publisher more than its floor.[872] A winning buyer would be charged

[869] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("[redacted]").

[870] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("[redacted]").

[871] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("[redacted]").

[872] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -357 ("[redacted]

the standard clearing price for the impression, plus a payment for any debt it had accrued, where this additional payment was chosen so that the total price of the impression was less than the bidder's bid.[873] If the buyer had set its own clearing price (by submitting a nonzero second bid), any additional payment it made as a consequence of its second bid was deducted from the debt balance as well.[874] The publisher would be paid the standard payment it would otherwise receive for the impression in the absence of DRS *minus* a share of any debt it had accrued *plus* a fraction of the buyer's repaid debt (with this fraction equal to the publisher's standard revenue share).[875] I give a more detailed mathematical description of the workings of DRS v2 in Section XV.E.4.

441. Note that when recouping debts, AdX pays a portion of the recouped buyer debt back to the publisher. These amounts were chosen exactly to ensure that there is no double-charging of debt and, assuming all advertiser debts are recouped, the net debt accruing on average to publishers is zero, as described in Lemma 1, proved in Section XV.E.5.

442. **Lemma 1:** Suppose that AdX recoups all debts under DRS v2. Then, buyers accrue the full debt on each impression (equal to the difference between the floor price that would apply in the absence of DRS and the price it pays under DRS v2) and, after accounting

[redacted].").

[873] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("[redacted].").

[874] Design Doc, "Dynamic Revenue Sharing (DRS) V2 Proposal" (Mar. 24, 2015), GOOG-DOJ-13221355, at -356 ("[redacted]").

[875] Launch Doc, "AdX Dynamic Revshare v2: Launch Doc" (Jan. 13, 2016), GOOG-DOJ-13207875, at -879 ("[redacted]").

every time it reduces AdX's revenue share. A minimally attentive buyer who failed to read Google's disclosure could still discover DRS by noticing when a bid below the floor price was accepted at a price equal to its bid and, by applying logic or just conducting routine experiments, optimize its bidding strategy to account for that possibility.

3. Non-Google Exchanges Also Dynamically Adjusted Revenue Shares

470. Professor Gans claims that only AdX had the requisite scale and incentive to implement DRS. He states, "Had Google not had monopoly power on the sell side of the market or been vertically integrated into the exchange market, it would not have had the ability or the incentive to undertake this conduct that harmed competition."[916] In fact, the same incentive applies to every exchange and the ability of other exchanges to undertake this conduct is revealed by the evidence. [redacted].[917]

[916] Expert Report of J. Gans (Jun. 7, 2024), at ¶ 777.

[917] *See* Deposition of [redacted] at 63:17-64:3 (Oct. 26, 2023), [redacted], at -064 to -065 ("[redacted]"); Presentation, "[redacted], at slide 33 ("[redacted]"); Presentation, "[redacted], at -717 ([redacted]).

XIII. OPEN BIDDING AND UNIFIED FIRST PRICE AUCTION: IMPROVING PUBLISHERS' ABILITY TO ACCEPT BIDS FROM NON-GOOGLE EXCHANGES

A. Overview

473. Google began testing **Open Bidding** (previously known as Exchange Bidding, and internally also known as Jedi, EBDA, and demand syndication) in 2016[925] and officially launched the program in April 2018.[926] Open Bidding allowed publishers to accept bids for impressions from non-Google exchanges on Google Ad Manager, increasing the thickness of Google's platform. Accepting bids from other exchanges on GAM—in a way that protected the interests of both advertisers and publishers—required careful design and ultimately led to other changes on GAM, including the transition to the Unified First Price Auction (UFPA) in 2019.[927]

474. Google described Open Bidding as its "answer to header bidding."[928] Relative to header bidding, Open Bidding brought many advantages to publishers, including speed, streamlined payments, simpler configuration, and reduced computational burden on end

[925] *See* Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -348.

[926] *See* Jonathan Bellack, "Exchange Bidding now available to all customers using DoubleClick for Publishers," Google Ad Manager (Apr. 4, 2018), https://blog.google/products/admanager/exchange-bidding-now-available-to-a/ ("Exchange Bidding now available to all customers using DoubleClick for Publishers […] With Exchange Bidding, publishers can increase revenue by allowing multiple exchanges to compete with each other—and with DoubleClick Ad Exchange—in a unified auction.").

[927] Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -662 ("[W]e are transitioning publisher inventory to a unified, 1st price auction for Google Ad Manager.").

[928] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337 ("Demand Syndication is our answer to header bidding - a superior product for allowing pubs to get per-query bids from non-AdX exchanges[.]").

users' browsers.[929, 930, 931] The popularity of Open Bidding among publishers speaks to these benefits.[932]

475. Plaintiffs' allegations regarding Open Bidding and the UFPA are factually incorrect and fail to account for the incentives of participants.

a. *First*, Plaintiffs' allegations that Open Bidding was devised to "maintain its exchange monopoly and exclude competition"[933] from other exchanges using header bidding is inconsistent with the details of the Open Bidding program. Contrary to Plaintiffs' descriptions, publishers and exchanges were not forced to adopt Open Bidding and could maintain existing header bidding configurations. The data I have reviewed suggests that the vast majority of publishers using Open Bidding continue to use header bidding.

[929] In this section, I use the term "header bidding" to refer to client-side header bidding. Some use the term "header bidding" to include server-side header bidding tools, including Open Bidding. For a comparison of Open Bidding and header bidding, see Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -440 to -442.

[930] For a comparison of timeouts, see Comms Doc, "RTB Timeouts" (Oct. 2019), GOOG-DOJ-15232606, at -609 ("Google's lower bid timeouts should have a slightly better user experience with lower latency").

[931] *See* Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24; Comms Doc, "Open Bidding on Ad Manager (fka Exchange Bidding)" (Aug. 2019), GOOG-DOJ-15389438, at -438 ("Eliminate operational inefficiencies such as line item complexity and latency that exists with header bidding […] Easy to set up, view/analyze reports and unified payments […] Allows exchanges to respond to RTB call-outs […] Provides integrated reporting and billing for exchange bidding transactions won by 3rd party exchanges"), -441 to -442.

[932] [redacted].

[933] Fourth Amended Complaint ¶ 367.

introduced in response to demands from buyer-customers and emerging privacy concerns. While Professor Gans asserts that "Google's claim that it redacted data based on privacy concerns is pretextual,"[937] he primarily justifies his opinion by a mischaracterized quote, ignores other evidence, and does not acknowledge Google's contractual obligations. Plaintiffs and their experts also fail to account for publishers' alternative means for measuring the "performance of exchanges in header bidding,"[938] such as experimentation and the use of other data fields.

B. Open Bidding: Google's Response to the Flaws of Header Bidding

476. Open Bidding was designed as Google's "answer to header bidding," incorporating more real-time bids from non-Google exchanges into Google's auction.[939] Although implementations of header bidding also enabled publishers to collect real-time bids from non-Google exchanges, those implementations tended to have several downsides, as described next.

[937] *See* Expert Report of J. Gans (Jun. 7, 2024), at Section VII.D.2 ("Google's claim that it redacted data based on privacy concerns is pretextual.").

[938] Fourth Amended Complaint ¶ 387.

[939] Presentation, "Demand Syndication" (Feb. 17, 2016), GOOG-DOJ-09459336, at -337 ("Demand Syndication is our answer to header bidding - a superior product for allowing pubs to get per-query bids from non-AdX exchanges.").

477. *First, latency.* Common implementations of header bidding increased latency.[940] An internal Google study found [redacted], and academic researchers found that header bidding latency was around three times that of the waterfall.[941] Latency not only degrades the end user experience, but in so doing, also harms advertisers and publishers.[942] By increasing the likelihood that an end user leaves the website before the ad is presented, latency harms publishers by potentially preventing a user from viewing an ad for which the publisher would be compensated if the ad had been displayed.[943] Latency also harms advertisers by reducing the effectiveness of online display advertising campaigns.

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[940] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Most header bidding has traditionally taken place client-side, meaning the page sends out requests to individual ad exchanges and other demand sources, processes the responses, and then runs an auction, all via Javascript code running on the page. This may introduce latency issues and slow page loads."). *See also* Presentation, "Header Bidding T1 Impact" (Sep. 24, 2015), GOOG-DOJ-04430492, at -501 ("3. User's browser triggers the buyer's pixel, which communicates with the Header Bidding buyer's server. a. This may result in page load latency as the page will not load until the header script completes […] 4. HB buyer's server returns a decision […] (This results in further latency as the DFP tag is dependent on the Header Bidder's call resolving.)"),-502 ("Cons: Increased latency - especially in mobile and video = decreased user experience."); Vishveshwar Jatain, "Understanding Header Bidding And How To Leverage It," Forbes (Sep. 17, 2019), https://www.forbes.com/sites/forbescommunicationscouncil/2019/09/17/understanding-header-bidding-and-how-to-leverage-it/?sh=332097315c1 ("Client-side header bidding […] increased page latency because executing auctions takes bandwidth and computing resources.").

[941] Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -956 ("[redacted]"); Pachilakis, M., Papadopoulos, P., Markatos, E. P., & Kourtellis, N. (2019). No More Chasing Waterfalls: A Measurement Study of the Header Bidding Ad-ecosystem. In *IMC '19: Proceedings of the Internet Measurement Conference* (pp. 280-293).

[942] Interactive Advertising Bureau, "Glossary: Digital Media Buying & Planning" (Apr. 2016), https://www.iab.com/wp-content/uploads/2016/04/Glossary-Formatted.pdf, at p. 10 ("Latency sometimes leads to the user leaving the site prior to the opportunity to see the ad.").

[943] *See, e.g.*, DoubleVerify, "Latency in Digital Advertising: A Guide for Publishers," DV Publisher Insights (Oct. 21, 2019), https://pub.doubleverify.com/blog/latency-in-digital-advertising-a-guide-for-publishers/ ("High latency kills user experience and publisher revenue."); Google, "[UA] Latency and why it impacts Google Ads Clicks and Analytics Sessions," Google Analytics Help (accessed July. 24, 2024), https://support.google.com/analytics/answer/4589209?hl=en ("As a general rule, users on the internet are not very patient. This is evident from studies such as the KissMetrics study that elicited some sobering statements like: 'A one-second delay in page response can result in a 7% reduction in conversions.' along with '47% of consumers expect a web page to load in two seconds or less.' What does this mean for you? If your website loads too slowly, then there is a possibility that users are leaving and going to your competitors, especially if competitors are able to deliver the same content quickly.").

478. *Second, payment discrepancies.* There were reports of payment discrepancies, where publishers' expected receipts from header bidders did not match eventual payments.[944] In contrast to impressions sold on AdX (where AdX would act as a clearinghouse, collecting payments from bidders on behalf of publishers), publishers needed to manage their own billing and reconciliation for impressions sold via header bidding. Discrepancies of up to 50% could arise because different partners might apply different standards for verifying that impressions were not fraudulent or double-counted.[945]

479. *Third, complexity.* Header bidding could be challenging for a publisher to configure, requiring it to place code in the header of its website to request, collect, and compare bids before calling the publisher's ad server.[946] Header bidding also required a publisher to

[944] Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 24 ("Header bidding is also not transparent because, although the publisher 'accepts' the impression at a certain price, the header bidder may not actually pay the sum indicated in its bid."); Presentation, "Header Bidding Observatory #1" (Jan. 2017), GOOG-DOJ-AT-01027937, at -955 ("A comparison of HB reports vs DFP reporting showed significant discrepancies [in revenue]"). *See also* James Curran, "For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger Opinion Page (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a 50% discrepancy between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a $2 CPM is really a $1 CPM once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[945] James Curran, "For Publishers, Header Bidding Discrepancies Can Outweigh Revenue Lift," AdExchanger Opinion Page (Jul. 8, 2016), https://www.adexchanger.com/the-sell-sider/publishers-header-bidding-discrepancies-can-outweigh-revenue-lift/ ("Publishers need to create a more realistic calculation of header bidding revenue by factoring discrepancies into their line-item valuations. Some header bidding solutions can cause up to a 50% discrepancy between the publisher ad server impression reports and the impression reports from the programmatic partner. That means a $2 CPM is really a $1 CPM once you account for the adjustments made by the exchange for viewability, verification and performance tracking.").

[946] One publisher described the time required to integrate an SSP with a leading header bidding wrapper as "20 hours of work" (versus Open Bidding's "20 minutes"). Sarah Sluis, "Google Ad Manager Builds A Bridge To Prebid—But Don't Call It A Two-Way Street," AdExchanger (Apr. 27, 2022), https://www.adexchanger.com/platforms/google-ad-manager-builds-a-bridge-to-prebid-but-dont-call-it-a-two-way-street/. Another industry source compared header bidding to previous ad configurations: "It's not just a little more work, it's probably 100X as much work to traffic for most publishers." Ad Ops Insider, "Header Bidding Explained Step-by-Step" (Jun. 8, 2015), https://www.adopsinsider.com/header-bidding/header-bidding-step-by-step/.

3. Google's Transition to the Unified First Price Auction Further Increased Efficiency

490. To understand why Google transitioned to a first-price auction, consider the requirements it faced. Suppose that the ad allocation process must (1) employ an "auction of auctions" in which the winning exchange is the one with the highest auction clearing price; (2) ensure that the clearing price in its auction depends only on the bids in its auction and not on the bids in any other auction (avoiding what others have called a "last look"); and (3) ensure that the highest net bid by any advertiser wins. Applying simple logic to these three requirements implies that the clearing prices in each exchange can depend only on the highest bid in that exchange's auction, and not on the second-highest bid, so the requirements cannot be satisfied if any exchange uses a second-price auction. To achieve these requirements, *all participating exchanges—including AdX—must use first-price auctions*. For AdX, the switch from its historic second-price auction to a first-price auction was a major change that would present new challenges for all its bidders, because they would need to adapt their bidding procedures to the new first-price auction rule.

491. After the eventual migration to the Unified First Price Auction was completed in September 2019, all bidders—including AdX bidders, header bidders, and non-Google exchanges using Open Bidding—competed on the same first-price basis, with the highest bidder paying its bid.[971] This change eliminated the inefficiencies and confusions caused by differences in auction formats, and removed the so-called "last look" over header bidding. It reduced transaction costs both for both bidders (who no longer needed to bid

[971] Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -663 ("After the transition is complete, all publisher traffic is on 1st auction").

differently in different exchanges) and publishers (who no longer needed to inflate header bids to set value CPMs for a second-price auction).

492. To ease the transition for its bidder customers to the new auction rules, Google Ads and DV360 introduced new programs to optimize their bids into the Unified First Price Auction. As discussed in Section IV.C.1.c, Alchemist optimized bids into the UFPA for Google Ads advertisers, while using threshold pricing to determine payments by advertisers.[972] The threshold prices made the Google Ads internal auction bidder-truthful for those advertisers. On DV360, Google determined bids into the UFPA on behalf of its advertisers (unless the advertiser opted out) using a bid optimization program similar to earlier versions of Poirot.[973] A winning DV360 advertiser would be charged its bid (plus any applicable platform fees).[974] This payment rule also incentivizes truthful reporting of campaign parameters so long as DV360 is trusted to determine the optimal bid shading factors on behalf of its advertisers. In combination, these programs maintained the simplicity of Google's buy-side tools, while allowing the bids from different demand-side platforms to be directly and simply compared.

493. Since the transition to the UFPA, Google has provided real-time bidders—including Authorized Buyers and Open Bidders—with historical auction information to allow

[972] Recall that this means that a Google Ads advertiser pays the lowest value it could have reported while still winning the impression. *See* Design Doc, "The Alchemist (AKA First Price Bernanke)" (Mar. 2019), GOOG-DOJ-14550102, at -103 to -104 (providing details on how the payment is calculated); Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 22.

[973] Declaration of N. Jayaram (Aug. 5, 2023), GOOG-AT-MDL-008842383, at ¶ 35 ("With the transition to a Unified First Price Auction, Google began providing minimum-bid-to-win data to buyers, and DV360 began to use that minimum-bid-to-win data to inform how Poirot would lower bids into AdX in order to optimize for expected advertiser surplus.").

[974] [redacted].

XIV. UNIFIED PRICING RULES: PROTECTING ADVERTISERS FROM PRICE-FISHING BY PUBLISHERS USING EXCHANGE-DISCRIMINATORY FLOOR PRICES

A. Overview

519. In 2019, at the same time as its transition to a Unified First Price Auction (UFPA), Google introduced Unified Pricing Rules (UPR), which enabled publishers to use a single interface in Google Ad Manager to configure and manage floor prices that apply to all exchanges and demand sources.[1041] These floor prices could vary by properties of the impression and advertiser, but not by the identity of the exchange or the buying tool used by the advertiser.[1042]

520. UPR ensured that advertisers faced the same floor prices on all bidding channels in the UFPA. Before Google introduced the UFPA, publishers using GAM could improve both efficiency and revenue by setting different floor prices for bidders or demand sources

[1041] *See* Sam Cox, "Simplifying programmatic: first price auctions for Google Ad Manager," Google Ad Manager Blog (Mar. 6, 2019), https://blog.google/products/admanager/simplifying-programmatic-first-price-auctions-google-ad-manager/ ("[I]n the coming months we'll start to transition publisher inventory to a unified first price auction for Google Ad Manager."); Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), http://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("In addition to impacting how publishers are using floor price rules, changing to a first price auction in Ad Manager requires a change in how our rules function. […] That's why we released a new feature to all publishers globally, called unified pricing rules.").

[1042] *See* Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -665 ("[redacted]"); Google, "Unified pricing rules," Google Ad Manager Help (Jun. 25, 2024), https://support.google.com/admanager/answer/9298008 ("Advertiser- and brand-specific pricing can be configured in unified pricing rules. They don't apply to remnant line items. Per-buyer and per-bidder pricing are not available."); Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("To maintain a fair and transparent auction, these rules will be applied to all partners equally, and cannot be set for individual buying platforms.").

depending on the order in which they were called. This important justification of setting different floor prices for different exchanges was eliminated in the UFPA, [redacted].[1043]

521. UPR benefited Google's buyer-customers. Although Google's Open Bidding had addressed some of the flaws of header bidding (as described in Section XIII), advertisers still faced the risk of self-competition, in which an advertiser partners with multiple DSPs or bids into multiple exchanges when those are competing for the same impression. In turn, publishers could exploit this advertiser multi-homing through a tactic known as **price-fishing**: by setting different floor prices for different exchanges, a publisher could increase its revenue at the expense of such advertisers. Internal documents suggest [redacted]. Facing a common floor price also simplified the bidding process for advertisers and DSPs, reducing the costs of evaluating the same impression that might be offered many times at different floor prices

[1043] *See* Email from [redacted], "Fwd: First-price & Removing pricing knobs" (May 11, 2019), GOOG-DOJ-06732979, at -980 ("[redacted]").

[1044] *See, e.g.*, Email from [redacted] et al., "Fwd: 1st Price Changes" (Jun. 10, 2019), GOOG-DOJ-12948968, at -969 ("[redacted].").

publisher's tactics, its best response is to bid less in an auction with a higher floor price, understanding that the same impression may be available via a different exchange at a lower price. However, such optimization is difficult, particularly because it is in the publisher's interest to hide from the advertisers that they are being called multiple times. One consequence would be the need for advertisers to invest in technology to track impressions and floor prices across exchanges to protect against the possibility of self-competition. If that proved too difficult or costly, [redacted].

C. Unified Pricing Rules Protected Advertisers and Benefited Publishers in the UFPA

535. Along with its launch of the Unified First Price Auction in 2019, Google introduced Unified Pricing Rules (UPR).[1062] Before the introduction of UPR, publishers could set floor prices in AdX for specific bidders, including Google Ads, DV360, non-Google DSPs, and ad networks. These floor prices were implemented via "pricing rules," with publishers able to configure up to 5,000 floor prices in this way.[1063] On the other hand,

[1061] *See* Deposition of [redacted] at 236:15-18 (Jul. 22, 2021), GOOG-AT-MDL-007177040, at -276 ([redacted]").

[1062] *See* Jason Bigler, "An update on first price auctions for Google Ad Manager," Google Ad Manager Blog (May 10, 2019), https://blog.google/products/admanager/update-first-price-auctions-google-ad-manager/ ("In addition to impacting how publishers are using floor price rules, changing to a first price auction in Ad Manager requires a change in how our rules function. […] That's why we released a new feature to all publishers globally, called unified pricing rules.").

[1063] *See* Lucie Laurendon, "Google Unified First Price Auction Explained," Smart Ad Server Blog (captured on Mar. 7, 2022) at

publishers could *not* use GAM to set floor prices for Open Bidding exchanges and other indirect sources of demand: instead, they needed to configure floor prices for each exchange separately using that exchange's user interface.[1064] The consequence of this piecemeal system was that "[p]ubs set different floors for the same buyer on different exchanges,"[1065] and, as a result, multi-homing advertisers—those who bid across multiple different channels—could face different floor prices for the same impression on different exchanges. As described above, these advertisers "struggle[d]" to de-duplicate impressions and coordinate bids made through different channels and, as a result, could be exposed to price-fishing tactics.[1066]

536. Under UPR, the same floor prices publishers set in GAM apply equally to AdX, other participating exchanges, and remnant line items (including any header bidding demand). This protected advertisers from publishers' price-fishing tactics. UPR did not prevent

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http://web.archive.org/web/20220307203150/https://smartadserver.com/articles/google-unified-first-price-auction-explained/ ("Publishers will only be able to set UPR with a limit of 200 (vs 5,000 OA rules before).").

[1064] *See* Comms Doc, "Ad Manager Unified 1st Price Auction" (Sep. 27, 2019), GOOG-DOJ-09714662, at -664 ("[redacted]"); Declaration of N. Korula (Aug. 4, 2023), GOOG-AT-MDL-008842393, at ¶ 40 ("However, publishers were unable to use the Google Ad Manager user interface to set pricing floors for Open Bidding partners and other indirect sources of demand trafficked through non-guaranteed line items. Instead, publishers had to undertake the complex and time-consuming task of configuring pricing floors separately on each exchange and network where their inventory was available.").

[1065] Presentation, "DRX Unified Yield Management Strategy Review" (Jul. 9, 2018), GOOG-DOJ-11781854, at -869 ("Pubs set different floors for the same buyer on different exchanges to simulate a real-time waterfall and soft floor the buyers (like DBM), and AdX primarily bears the brunt of these higher floors").

[1066] *See* Presentation, "Unified 1st Price Auction" (Mar. 4, 2019), GOOG-DOJ-06525908, at -915 ([redacted]). *See also* Sarah Sluis, "Header Bidding Unleashed a Huge Infrastructure Problem and Ad Tech Will Either Sink or Swim," AdExchanger (Apr. 24, 2017), https://www.adexchanger.com/platforms/header-bidding-unleashed-huge-infrastructure-problem-ad-tech-will-either-sink-swim/ ("Though DSPs are seeing a flood of new impressions, many of them are selling the same thing. A publisher with three header bidding partners will have three exchanges sell its inventory, tripling the amount of impressions a DSP must evaluate and tripling the listening cost. […] [M]any DSPs are devoting resources to deduplicating impressions to avoid spending millions in server fees. […] But not all DSPs have the resources to smartly filter out low-value impressions.").

from the gross revenue to obtain the **net revenue** $NR = GR - rebated\ amount$,

which can be calculated as $NR = 12.91801 - \frac{2}{3} = 12.25134$.

Paul R. Milgrom, Ph.D.

July 30, 2024